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**Franciene Oost**

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**Franciene Oost**

**Sustainability of Urban Agriculture:  
a comparison of Dakar and  
Amsterdam**

*Master thesis*

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**Author:** Bc. Franciene Oost

**Supervisor:** Ondřej Horký-Hluchář, Ph.D.

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## **Abstract**

This paper discusses urban agriculture in Dakar and Amsterdam and its contribution to urban sustainability. Therefore, it establishes an operational definition of urban sustainability, which is comprised of economic, social and environmental dimensions. It gives an insight in urban agriculture in both cities, and it analyzes its contribution to urban sustainability by examining the economic, social and environmental issues which are related to urban farming. Furthermore, it gives an insight in the differences of urban agriculture in the global South and the global North. Its findings suggest that although urban agriculture has potential for creating more sustainable cities, there are several constraints which need to be overcome.

## **Abstrakt**

Diplomová práce zkoumá městské zemědělství v Dakaru a Amsterdamu a jeho přínos k udržitelnosti města. Ustavuje operační definici udržitelnosti města tvořenou ekonomickými, sociálními a environmentálními rovinami. Přibližuje městské zemědělství v obou městech a analyzuje jejich přínos k udržitelnosti zkoumáním ekonomických, sociálních a environmentálních problémů vztahujících se k městskému zemědělství. Přináší představu o rozdílech mezi městským zemědělstvím na globálním jihu a severu. Výsledky naznačují, že i když má městské zemědělství potenciál vytvářet více udržitelná města, je tu stále několik problémů, které je nutné překonat.

## **Keywords**

Urban agriculture, urban sustainability, global South, global North, Dakar, Amsterdam

## **Klíčová slova**

Městské zemědělství, udržitelnost města, globální jih, globální sever, Dakar, Amsterdam

**Range of thesis: 77 pages, 174.318 characters**

## **Declaration of Authorship**

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.
2. The author hereby declares that all the sources and literature used have been properly cited.
3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague 17.05.2013

Franciene Oost .....

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# Institute of Political Studies

## Master thesis proposal

### Master Thesis Proposal

Institute of Political Studies  
Faculty of Social Sciences  
Charles University in Prague

Date: 24.10.2012

<b>Author:</b>	<b>Franciene Oost</b>	<b>Supervisor:</b>	<b>Ondřej Horký-Hlucháň Ph.D.</b>
<b>E-mail:</b>	franciene_oost@hotmail.com	<b>E-mail:</b>	horky@iir.cz
<b>Specialisation:</b>	IEPS	<b>Defense Planned:</b>	May/June 2013

#### Proposed Topic:

**Sustainability of Urban Agriculture: a comparison**

**Registered in SIS:** Yes

#### Topic Characteristics:

This paper will study the development of urban agriculture. Cities in developing countries such as in sub-Saharan Africa are growing very fast, which imposes economic, social as well as environmental problems. However, some believe that urban agriculture has a positive effect on the development of these cities. In order to find out how these cities can develop in a sustainable way, we need to examine the effects of urban agriculture, its opportunities and its challenges. The situation in some developing countries with regard to food security is critical, and deserves attention. Food is essential to our daily lives: we need to find a way to feed our growing world population. Moreover, we need to take into account that some of our resources are limited, which has an impact on our future capacities. Thus, it is necessary to examine the opportunities which urban agriculture offers to deal with some of the challenges in developing countries. On the other hand, it is interesting to find out more about the role and opportunities in the developed world. In countries which are more and more specialized in industry and services, urban agriculture might not offer the same opportunities. In order to find out what the differences are between urban agriculture in the South and the North, this paper will focus on two cases, one in the South (Dakar) and one in the North (Amsterdam). Urban agriculture is a complex issue, which is related to economic, social, environmental, political and cultural factors. Although studies have been done of different aspects of urban agriculture, it is necessary to bring them together in order to determine whether it is sustainable or not. Therefore, this paper aims at establishing a concept of sustainability, which comprises economic, social, environmental and political factors. Thus it can analyze the sustainability of urban agriculture.

#### Working hypotheses:

1. Hypothesis #1: Urban agriculture in developing countries is more important for food security than in developed countries
2. Hypothesis #2: Urban agriculture can improve environmental quality



3. Hypothesis #3: Lack of economic efficiency in urban agriculture can be compensated by an increase in food security and environmental quality.
4. Hypothesis #4: Stricter legislation can enhance the opportunities of urban agriculture in developing countries.
5. Hypothesis #5: Urban agriculture can be sustainable, despite its challenges.

### **Methodology:**

Before analyzing the sustainability of urban agriculture, this paper will first try to establish a theoretical framework which can be applied. It is necessary to define the concept of sustainability, which has changed significantly over the years and has different meanings in different contexts. This paper will focus on the multidimensional aspect of sustainability: it looks at social, political, environmental aspects and not merely economic. As such, it provides us with a tool to approach the different factors which play a role in urban agriculture. It helps us to take into account both opportunities and challenges of urban agriculture, on which this paper will base its analysis. In order to establish the concept of sustainability, it makes use of the existing literature in the field. The empirical analysis of the paper will be based on two cases of urban agriculture, one in the Global South (Dakar) and one in the Global North (Amsterdam).

### **Outline:**

- Introduction
- State of the Art
- Establishing a theoretical framework: the concept of sustainability
- Introduction to urban agriculture
- Analysis of urban agriculture on the basis of two selected cases:
  - Dakar:
    - Characteristics
    - Opportunities
    - Challenges
  - Amsterdam:
    - Characteristics
    - Opportunities
    - Challenges
- Conclusion
- Bibliography

### **References / Bibliography:**

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## Introduction

The world today is highly globalized, which means that it faces transactions of goods and services all around the globe at an amazing speed. The process of globalization seems to be unstoppable and its pace increasing even more. In the global North, globalization has been advocated as a positive development for a long time. It has been linked to increasing economic growth, technological advances, and changing patterns of communication and transportation. It has created a world, in which space and time have become more relative. However, during the last decades, the undesirable effects of globalization have gained more attention. People are more and more aware of the negative consequences of ever increasing economic growth. They are concerned about environmental issues such as the depletion of natural resources, climate changes such as droughts and extreme weather, and air, ground and water pollution. Furthermore, we have faced several economic crises during the last years, as a result of which certain capitalist ideas have come under pressure. Moreover, a series of scandals related to foodborne diseases such as the addition of melamine to milk in China in 2008 and an outbreak of the E. Coli bacteria in Germany in 2011 made consumers suspicious about the quality and origin of the products they buy. In addition, rising oil prices and low harvest due to extreme weather conditions in different parts of the world led to a global food crisis in 2008 which particularly affected the world's most poor.

As a result of growing concerns about the future of our globe, 'sustainability' and 'sustainable development' have become important topics on the national as well as international policy agendas. During the last decades, efforts have been made to reduce pollution, to mitigate CO<sub>2</sub> emissions and to find greener alternatives to energy based on fossil fuels. Nevertheless, one of the issues which remain insufficiently discussed is our food consumption. In the global North, we take it for granted that we have a wide range of products from which we can choose in the supermarket, flown in from all over the world. However, we do not always realize how dependent we are on fossil fuels for the growing, manufacturing, transportation and preparation of our food. On the other hand, countries in other parts of the world have to deal with food shortages: 870 million people do not have enough food to eat (FAO, 2012). In addition, climate change imposes a challenge to our current agricultural production systems: "long term changes in the patterns of temperature and precipitation, that are part of climate change, are expected to shift production seasons,

pest and disease patterns, and modify the set of feasible crops affecting production, prices, incomes and ultimately, livelihoods and lives (FAO, 2010, p. iii).

While climate change is transforming the weather conditions and the nature on our globe, also demographic changes can be observed. During the last century, we have seen as massive influx of people into the cities. By now, more than half of the world's population is residing in urban areas and this number is expected to increase even more (United Nations, Department of Economic and Social Affairs, Population Division, 2012). The table below illustrates the increase of urban population on the global scale, as well as for the individual countries of Senegal and the Netherlands and the prospects for the future.

Country/Region	1970	1990	2010	2030
<b>World</b>	36.6	43.0	51.6	59.9
<b>Senegal</b>	30.0	38.9	42.3	50.8
<b>Netherlands</b>	61.7	68.7	82.7	87.8

**Table 1. Percentage of population residing in urban areas.**

Based on: United Nations, Department of Economic and Social Affairs, Population Division. (2012). Percentage of population residing in urban areas, 1950-2050. In *World Urbanization Prospects: The 2011 Revision, CD-ROM Edition*.

On the one hand, cities are economic, political and social centres and drivers of globalization. Although they play an important role in economic development, their high concentration of people, cars and other originators of pollution has a negative impact on our environment. On the other hand, cities are centres of innovation: these are the places where change can and needs to occur. Put differently, 'there can be no sustainable world without sustainable cities' (Deelstra & Girardet, 2000, p. 43). In order to find out more about the dynamics of cities and their role in the change of our agricultural production systems, this paper studies the development of urban agriculture. More specifically, the aim of this paper is to find out to what extent urban agriculture contributes to the sustainability of cities.

Cities in developing countries such as in sub-Saharan Africa are growing very fast, which imposes economic, social as well as environmental problems. Furthermore, the expansion of cities involves a high degree of informal settlements, which makes it difficult for municipal governments to get a hold on the situation. However, some believe that urban agriculture has a positive effect on the sustainable development of these cities (e.g. Smit et al,

2001; Mougeot, 2005; van Veenhuizen, 2006). In order to find out how these cities can develop in a sustainable way, we need to examine the effects of urban agriculture, its opportunities and its challenges. On the other hand, it is interesting to find out more about the role and opportunities of urban agriculture in the global North. In countries which are more and more specialized in industry and services, urban agriculture might not offer the same opportunities. Nevertheless, we can observe a trend in the development of agricultural activities in urban and peri-urban areas.

In order to explore the sustainability of urban agriculture, this paper will study two different cases. With the aim of exposing differences as well as similarities between the global South and the global North, it will discuss urban agriculture in Senegal and the Netherlands. The main research question of this paper can therefore be summarized as follows: *‘to what extent does urban agriculture contribute to the sustainability of Dakar and Amsterdam and what are the differences and similarities between urban agriculture in these two cities?’*. Thus, this paper aims to expose the development, challenges and opportunities of urban agriculture, to give an insight in the dynamics of cities, and to explore the possibilities for a sustainable future in cities of both the global South and North.

In order to answer the research question, this paper will be structured as follows: the first chapter deals with the methodology. It gives a definition of urban agriculture, defines the scope of the paper and establishes a methodological framework for the study of the cases of Dakar and Amsterdam. The second chapter discusses the case of Dakar. It sheds light on the current issues of sustainability in Dakar and explains the relationship between urban agriculture and sustainable development of the city. The third chapter discusses the case of Amsterdam, a contrasting case from the global North which gives a different perspective on urban agriculture. As for Dakar, economic, social and environmental sustainability issues in the Dutch capital are discussed and analyzed. The paper concludes with a comparison of both cases and final remarks.

# 1. Methodology

Before one can assess the extent to which urban agriculture contributes to a more sustainable future for cities, it is necessary to understand what urban agriculture entails. Therefore, this chapter gives an introduction into the dynamics of urban agriculture. First, gives a short overview on the existing literature on urban agriculture. Second, it discusses the increase of popular and scholarly attention to urban agriculture during the past decades. Third, it explores the differences of urban agriculture in the global South and North. Fourth, it explains the scope of this paper, which will be dealing mainly with arable farming and horticulture in urban and peri-urban areas.

Furthermore, this chapter establishes a methodological framework which will be used for the research on urban agriculture in Dakar and Amsterdam. In order to determine whether it has a positive effect on sustainable development of urban areas, it is necessary to give a clear concept of sustainability, which can be applied to the cases of Dakar and Amsterdam. Therefore, the second part of this chapter deals with the complexity of sustainability. First, it discusses the development of the concept of sustainability over time. Second, it establishes a concept of sustainability which is suitable for application to urban development. This concept is comprised of economic, social and environmental criteria. Third, it explains the subcriteria which determine the economic, social and environmental conditions of urban agriculture. Together, the economic, social and environmental criteria and their subcriteria constitute a framework for analysis of urban agriculture.

Moreover, the third section of this chapter gives reasons for the selection of the cases of Dakar and Amsterdam. It explains why the method chosen for this research is a comparative case study with such contrasting cases and it elaborates on the operationalization of sustainability<sup>1</sup>.

## 1.1. Urban Agriculture

### 1.1.1. Urban Agriculture: an overlooked issue?

Most authors agree that urban agriculture can be defined as agricultural activity such as the growing of fruits and vegetables and keeping livestock in the city or on its edges (e.g.

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<sup>1</sup> Due to the sophisticated research design with an operational definition of urban sustainability, the hypotheses as stated in the proposal have become superfluous. Therefore, they have not been incorporated in the final text.



Veenhuizen, 2006; Mougeot, 2005; Lee-Smith, 2010). One of its characteristics is that it is usually performed on a small scale, either for personal use only, for commercial goals, or even both. It may seem illogical to grow plants in places where land is scarce, expensive and, in some cases, polluted. However, when it comes to commercial agricultural activity, urban farmers have the advantage of being close to the market: cities provide useful networks for exchange of products and services. But urban agriculture can also serve as a means to provide families with more or better food. Moreover, some urban farms are incorporated in cities, due to urban expansion: cities become bigger and absorb the villages around it. Foeken et al. state that urban agriculture can be performed ‘in one’s own compound (‘backyard farming’ or ‘on-plot farming’) or on land belonging to someone else (‘off-plot farming’), the owner being the government, an institution or a private individual (Foeken et al., 2004, p. 1).

Mougeot argues that urban agriculture ‘remains largely unrecognized, unassisted, or discriminated against, when not outlawed or harassed, even in years of food shortage’ (in: Egziabher et al., 1994, p. 10). Nevertheless, he finds that in several countries all over the world, (urban) agricultural departments are set up on national, local as well as municipal governing levels, which regulate, support and stimulate farming in cities. Compared to half a century ago, when urban agriculture was prohibited in a large number of African countries, this is a significant change. A few tools which governmental authorities can use are, among others, tax benefits, regulations on the use of land, agricultural permits, or even making land available for urban agriculture.

### **1.1.2. Increasing attention for urban agriculture**

Urban agriculture is not a new phenomenon, but as explained above, it has been overlooked. Nevertheless, during the past decades, it deservedly gained more popular and scholarly attention. According to Appeaning Addo, ‘urban agriculture contributes substantially to food security and safety for approximately 50% of city dwellers worldwide’ (Appeaning Addo, 2010, in: Arku et al., 2012, p. 1). Thus, urban agriculture plays a fundamental role in feeding the urban population. Furthermore, the authors of ‘Cities Feeding People’ suggest that urban agriculture in African countries will probably increase, due to ‘persisting unemployment, retrenched civil service, newcomers added yearly to the local labour pool, sheer population growth, women at home resorting to UA, and a growing urban demand for abundant, regular, and cheap supplies of good-quality food’ (Lundu, 1993, in: Egziabher et al., 1994, p. 9).

Urban agricultural activities in Africa range from growing crops to having livestock. Popular products which are grown are ‘mostly basic food crops such as maize, beans,

cassava, sorghum, rice and yams' (Foeken et al., 2004, p. 2). More luxury products (such as tomatoes and leafy vegetables) are less popular and usually grown only for commercial purposes. Trees are unusual as well, because urban farmers face high uncertainty with regard to access to land. In addition to vegetable growing, some urban farmers keep livestock. However, this is less common and usually limited to a small number of animals, which are either kept in one's own compound or left grazing outside along public roads. Popular animals for livestock keeping are chicken and cattle which can provide the farmer with dairy. Foeken et al argue that 'the commercial aspect of livestock keeping is generally of more importance than with crop cultivation, particularly when it concerns the selling of milk, eggs and chickens' (ibid, p. 2).

To a certain extent, city farmers face similar challenges as rural farmers: their activities can be constrained by 'irregular rainfall, drought, flooding, water-logging, poor soils, pests and diseases, and the destruction of crops by animals', to mention a few issues (ibid, p. 3). However, there are other issues which specifically urban farmers face, such as 'uncertainty regarding land tenure, the theft of crops and animals, a lack of capital and inputs, the threat of eviction and the possible destruction of crops' (ibid, p. 3). Furthermore, the quality of their crops may be affected because of urban pollution and contaminated water. On the other hand, it is argued that urban farmers themselves impose constraints on the environment. Keeping livestock on small compounds or even on public lands results in excessive animal waste. Furthermore, the animals cause unpleasant smells and noise, they form a danger to the traffic, and they can carry diseases. Moreover, 'since urban farming tends to be more intensive than rural farming, the use of chemical fertilisers, pesticides and insecticides can have a negative impact on the urban environment, causing pollution in not only the plants but also the soil and groundwater' (ibid, p. 3).

These negative aspects have long been used by policymakers as arguments to restrict urban agriculture. However, during the last decades, more attention has been given to (potential) benefits of farming in the city. It provides work for those who are unemployed, especially women. Furthermore, it increases food security, not only by increasing the quantity of products produced but also enabling families to provide themselves with more diversity in their diets.

In the global North, where food security is generally not an issue, urban agriculture plays a different role. It can be considered to be more appropriate in cities in the global South, in order to compensate food shortages and provide the poor with extra income. In the North, more emphasis lays on large scale specialized agriculture, with the aim of producing quality

food at high quantities and low prices. After the Second World War, policies were aimed at preventing hunger and the solution was found in large scale agriculture. The world turned rapidly into a global marketplace, where food products are produced on a large scale, after which they are transported all over the world. The consumer can choose wide range of products from different origins, fresh and cheap.

However, during the last years, the disadvantages of these policies have become clear. Farmers have difficulties to survive, and need to diversify the production of products or find additional employment, in order to earn enough money (e.g. Deelstra et al, 2001). Furthermore, a range of crises related to foodborne diseases has made people more suspicious about the products they buy. Data from the World Health Organisation show that ‘in industrialized countries, the percentage of the population suffering from foodborne diseases each year has been reported to be up to 30%. In the United States of America (USA), for example, around 76 million cases of foodborne diseases, resulting in 325,000 hospitalizations and 5,000 deaths, are estimated to occur each year’(WHO, 2007). Because of the globalized market, it is difficult to determine the origins and production process of a product. Therefore, consumers long back to community based markets, where they can more easily determine where and how a product is produced. In our global world, cities are economic and social centres. They compete with each other, with the aim of attracting the best businesses and employers. Therefore, it is in the interest of politicians and city planners to create agreeable space for people and businesses to locate themselves.

Thus, we can see that the interests of several parties such as farmers, consumers, businesses and politicians have changed. This is in line with the opinion of Deelstra et al., who argue the following:

*“At the same time, in a globalising and urbanising world in which cities compete with each other to attract inward investment, local politicians are seeking to create high quality, healthy, attractive living environments for their own citizens, and to attract businesses from elsewhere. Urban planners, along with the rest of society, realise that a mixture of land use with its ecological benefits, more attractive landscape and environmental benefits in the form of reduced transport needs is preferable to the separation of functions” (ibid, p. 2).*

As a result, the urban landscape in Europe is changing, and what is more: agriculture increasingly plays a role in the design of cities. According to Deelstra et al, there are several

ways to merge the different interests and include urban agriculture into successful city planning:

*‘The good news is that many possible win-win situations exist to meet the challenges faced by urban planners as they seek to create attractive land use combinations to meet the policy aims of various groups and satisfy the demands placed on scarce land in and around cities’. Many of these combinations can be based on urban agriculture (ibid, p. 2).*

The authors points to the possibilities of combining agricultural activities with services such as child care and educational facilities. Furthermore, they argue that the production of reed and aquaculture could be combined with recreational facilities, water storage and waste water treatment. Moreover, farmers could expand their businesses by ecotourism and/or by processing and selling agricultural products such as cheeses, jams and cosmetics. Also forestry in urban areas could provide opportunities for recreation and energy crops (ibid, p. 2). They support these statements with a case study on the city of Delft, in the Netherlands.

Ingo Zasada (2011) gives another perspective on urban agriculture in Europe. He argues that due to the expansion of cities, land has become a scarcer resource. He points out that this leads to certain problems: the land around cities becomes increasingly expensive, which makes it attractive for farmers to sell it and make it available for urban expansion. Clearly, this leads to a decrease in farms and loss of productive and fertile land. However, he also discusses the opportunities and developments which come with the growth of cities at the expense of agricultural land. He argues that the former agricultural function has been replaced by other functions, which are shaped according to the demands of consumers. For example, ‘increased standards of living and extended leisure time of urbanites are mirrored by a tendency to purchase regional organic food, spend leisure time in the near countryside, or even to permanently settle down in the countryside around towns’ (Zasada, 2011, p. 640). Zasada agrees with Deelstra et al. that cities are competing with each other by attempting to create attractive working and living environments.

To conclude, there has been an increase in interest in urban agriculture, both in the global South and North, each for different reasons. In the South, where hunger is a prevalent issue in many areas, urban agriculture is seen as a positive contribution to food security. In the North, urban agriculture has more to do with creating an attractive living environment and finding alternatives to the current food system.

### **1.1.3 Scope of this paper**

As explained above, urban agriculture can refer to any kind of agricultural activity within or at the edge of urban areas, from producing fruits and vegetables to keeping livestock for dairy or meat production. In some cases, livestock and arable farming or horticulture can complement each other: livestock produces waste that can be used as fertilizer, whereas the cultivations of crops can contribute to the amount of animal feed. However, they are two distinct types of farming with different techniques, benefits, needs and impacts on the environment. In order to remain within the limits of this paper, the research will focus on arable farming and horticulture. Therefore, the term urban agriculture in this paper refers only to the cultivation of crops such as vegetables, fruits, grains and mushrooms within urban and peri-urban areas.

### **1.1.4. Differences in urban agriculture between the global North and South**

We can see that urban agriculture in the South as well as in the North has gained more attention during the last years, each for different reasons. In the South, urban agriculture is a means for people to increase their income and improve their diets. The cities in the South are growing at an enormous speed and therefore the demand for food in the cities increases as well. Moreover, countries in the South are dependent on imports of food products from other countries, which makes them vulnerable to rises in oil prices or other events which negatively affects the world food market. This is illustrated by the global food crisis of 2008, which especially hit low-income countries. In such cases, it becomes clear that food security is not self-evident in the cities of developing countries.

In the North, urban agriculture now develops as a more sustainable alternative to the current system of food production rather than out of necessity. In the North, people are less affected by events such as a global food crisis and can count on a stable supply of food products. Furthermore, the current food system is designed in such a way as to provide them with large quantities at low prices. It is time consuming to grow vegetables in an urban garden and people are not necessarily better off economically. For many, it is a way of spending leisure time and not an income generating activity. However, because of the limits and potential health risks of conventional agriculture, people are increasingly interested in alternative ways of producing food, including urban agriculture.

Not only are the motives for people to engage in agricultural activities different in the North and South, but also the conditions. Depending on the location and climate, people in the South faces more difficulties in obtaining the required inputs for farming, such as land,

clean water, fertilizers, and agricultural tools. Reasons for this can be financial but also infrastructural: the quality of infrastructure partly determines the accessibility of products. In the North, people have better access to agricultural inputs: they can afford it and because of good infrastructure it is easier to purchase the necessary products. Furthermore, in the South, urban agriculture is used for home consumption and income substitution. Therefore, urban farming remains restricted to the growing of fruits and vegetables as such. In the North, however, urban agriculture has more functions: in several cases, it is combined with other projects. Farming can be combined with to recreation and ecotourism. But some projects also aim at other social functions, such as reintegrating people with physical or mental problems in the society and/or labour market. Furthermore, some projects have an educational aspect: they educate children or other interested people about nature, sustainability and food production.

## ***1.2. Sustainability***

### **1.2.1. Historical overview of the concept of sustainability.**

The concept of sustainability is addressed and used by many academic disciplines and its interpretations are various. Originally, however, it belongs to the field of ecology. The focus of this discipline is on ecosystems, and sustainability therefore referred to their ‘potential for subsisting over time, with almost no alteration’ (Yabareen, 2008, p. 181). This concept is based on an environmental perspective, without taking the society or economy into account. The social and economic aspects became included with the introduction of the concept of ‘sustainable development’. Whereas ‘sustainability’ refers to the goal as such, ‘sustainable development’ is the process by which this goal can be achieved.

There always seems to be a conflict between the environment and economic progress. However, scholars have developed sustainability theories during the last year, which allow merging environmental, economic and social interests into the sustainability concept. During the 1960’s it became clear that there are limits to economic growth. Several scholars such as Paul Ehrlich (1968), Garret Hardin (1968) and members of the Club of Rome pointed to the negative consequences of purely economic progress. Paul Ehrlich argued that the world would not be able to feed its population, if the population would continue to grow at the same rate. He therefore referred to the world as ‘The population bomb’ (Ehrlich, 1968, in: Quental, Lourenco, & Silva, 2011). A similar point was made by member of the Club of Rome in the 1970s, who pointed out that ‘if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years’ (Meadows

et al., 1972, in: *ibid*, p. 265). Garret Hardin became famous because of his theory on ‘The Tragedy of the Commons’ (1968, in: *ibid*, p. 264). He emphasized the self-interest of people and argued that without proper regulation, this self-interested behaviour would in the end lead to depletion of common resources and damage to our environment. The reason for this is that people act in their own interest, instead of in the collective interest. Therefore, government intervention is needed to prevent a tragedy of the commons.

Popular and scholarly attention to the issue of sustainability made it clear that action should be undertaken, not only at local, but also national, regional and global levels. The Brundtland Commission, which was established by the United Nations in 1982, published a famous report in 1987 on sustainability and formulated an agenda for global change. Their definition of sustainable development is ‘the development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (WECD, 1987). By referring to the needs of future generations, this definition includes an intergenerational aspect. Furthermore, it is important to recognize that there might be a difference between the needs of the current generation and future generations: they are not necessarily the same. Economic, social and environmental conditions change over time, and so do the needs of people.

### **1.2.2. Urban sustainability**

The previous section discussed the development of the concept of sustainability over time, and explained how environmental, economic and social issues became merged into one concept. Furthermore, the definition of the Brundtland commission included an intergenerational aspect which refers to the temporal dimension of sustainability and the goal to meet the needs of both current and future generations. However, what has not been discussed so far is the spatial dimension of sustainability.

Sustainability is linked to economic, social and environmental issues which are not constrained by borders and can occur on local, regional, national or global levels. If we take for example the issue of climate change, we can see first of all that it is a result of greenhouse gasses which are emitted all over the world. Second, the effects are also identifiable on places all over the globe, such as shrinking glaciers, extreme droughts in certain regions and floods in other regions, and changes in natural vegetation. It is an example of an environmental issue that is caused by actions everywhere in the world and has effects globally. Furthermore, actions that can foster sustainability locally may have adverse effects elsewhere. Alexey Voinov (2008) points to this problem as well:

*'[W]e should realize that sustainability in lower hierarchical levels, in subsystems of the global system, may work against sustainability of the whole, the biosphere. Achieving sustainability at some regional level, we may decrease sustainability of the biosphere as a whole by reducing the potential for change and adaptation. The more sustainable the regional systems are, the less the potential for maneuver, for evolution through renewal, the less the chances for a sustainable global system' (Voinov, 2008, p. 496).*

However, it is difficult to take action at the global level: for global sustainable measures, consensus is needed among countries, international institutions and businesses all over the world. The example of the Kyoto Protocol clearly illustrates this problem: the protocol which was designed to reduce greenhouse gas emissions globally was signed but not ratified by the United States, one of the biggest emitters on the globe.

Although certain problems need to be addressed globally, that does not mean that there should be no attention for local sustainability. At local and regional levels, people have their own needs which need to be fulfilled for their sustainable future. As this paper looks at how urban agriculture contributes to the sustainability of Dakar and Amsterdam, it needs a more specific concept of sustainability which can be applied to cities. The UN Habitat Agenda gives an extensive definition of urban sustainability which gives a good overview of issues that should be taken into account when studying the sustainability of a specific city:

*'Sustainable development is essential for human settlements development, and gives full consideration to the needs and necessities of achieving economic growth, social development and environmental protection. [...] Human settlements shall be planned, developed and improved in a manner that takes full account of sustainable development principles and all their components, as set out in Agenda 21 and related outcomes of the United Nations Conference on Environment and Development. Sustainable human settlements development ensures economic development, employment opportunities and social progress, in harmony with the environment. [...] Production, consumption and transport should be managed in ways that protect and conserve the stock of resources while drawing upon them. Science and technology have a crucial role in shaping sustainable human settlements and sustaining the ecosystems they depend upon. Sustainability of human settlements entails their balanced geographical distribution or other appropriate distribution in keeping with national conditions, promotion of economic and social development, human health and education, and the conservation of*



*biological diversity and the sustainable use of its components, and maintenance of cultural diversity as well as air, water, forest, vegetation and soil qualities at standards sufficient to sustain human life and well-being for future generations'. (UN Habitat Agenda, 1996).*

A more comprehensive concept of urban sustainability was established by the Sustainable City Conference in Rio in 2000, which defines it as 'the ability of the urban area and its region to continue to function at levels of quality of life desired by the community, without restricting the options available to the present and future generations and without causing adverse impacts inside and outside the urban boundary' (in: Voinov, 2008, p. 497). This paper will build on this concept of urban sustainability, and in its operationalization it will distinguish between economic, social and environmental criteria.

One might wonder whether a fourth criterion should be included: a political or institutional one. Naturally, institutional and political factors play an important role in sustainability, also on municipal levels: they provide for rules and frameworks which shape the economy, social relations and environment of a society. They can have a positive and stimulating role, but also impose challenges and restrictions on each of the three components. Therefore, the author of this paper argues that institutional sustainability is a prerequisite for economic, social and environmental sustainability, rather than a separate element of the concept of urban sustainability. Consequently, the discussion of the three criteria of sustainability automatically conveys institutional and political factors. In order to gain in depth understanding of the concept of urban sustainability, the following sections will explore its economic, social and environmental dimensions in further depth.

#### **1.2.2.1 Economic sustainability**

When looking at the economic component of sustainability, we can distinguish a number of sub criteria which determine whether urban agriculture contributes to the economic sustainability of a city. First of all, this paper investigates the effect of urban agriculture on the income of urban dweller. It examines if and how urban agriculture improves the economic situation of the farmers and their families. Second, it examines the effects of urban agriculture on the labour market. It looks at how urban agriculture directly and indirectly stimulates the creation of jobs. Third, it looks at access to land and water, which are essential elements for farming. Fourth, it discusses the efficient use of materials and products in the urban agricultural sector. The use of (natural) resources is an important element of sustainability, and its decline can partly be attributed to the current food system. Therefore, this paper

examines if and how urban agriculture can relieve some of the pressure on the world's natural resources.

#### **1.2.2.2. Social sustainability**

According to Haughton, 'the social dimension is critical since the unjust society is unlikely to be sustainable in environment or economic terms in the long run' ( Haughton, 1999, p. 64, in: Jabareen, 2008, p. 183). As for the economic dimension of sustainability, the social dimension also encompasses several criteria. First, this paper looks at the contribution of urban agriculture to food security. Second, it looks at participation of different social groups in urban farming, such as women and (partially) disabled persons and at other effects of urban agriculture at the urban community. Third, it examines whether urban agriculture has negative or positive effects to the health of the urban dwellers. Fourth, it investigates the reciprocal relationship between urban agriculture and education.

#### **1.2.2.3. Environmental sustainability**

Several authors point to the positive effects of urban agriculture on the urban environment, such as improved air and soil quality and a reduction in use of fossil fuels due to the decrease in transportation over great distances and the use of organic fertilizers (e.g. Smit et al., 2001; Mougeot, 2005; Deelstra & Girardet, 2000). The economic dimension already discusses the efficiency of use of materials, including natural resources, but the environmental sections deal with the other effects which urban agriculture has on the urban environment directly. As for economic and social sustainability, there are also sub criteria for environmental sustainability. First, this paper looks at the relationship between air quality and urban agriculture. Second, it examines how urban agriculture affects water management. Third, it investigates the relationship between soil quality and urban agriculture. Fourth, it looks at the use of pesticides and chemical fertilizers in urban farming and its effects.

### ***1.3. Comparative Case Study***

#### **1.3.1. Qualitative research: a comparative case study**

In order to give in-depth information about the dynamics of urban agriculture, the research of this paper is rather qualitative than quantitative. One of the disadvantages is that from a small selection of cases, it is not appropriate to draw generalizations. For example, conclusions which are drawn from the case of Dakar do not necessarily apply to similar cases such as those of capitals of neighbouring countries or cities in Asia, because not all of the conditions

are the same. The same problem applies to the case of Amsterdam: conclusions on Dutch urban agriculture are not necessarily the same as those which you could draw from German, Belgian or French cases.

However, the advantage is that it gives a better insight in the specific case. Relations between certain conditions and issues can be better explained when focusing on a smaller number of cases. Limiting the number of cases and increasing the variables which are taken into account enables us to gain better understanding of the selected cases. The reason for this is that it makes it possible to explore the complexity of the case. Although it is more difficult to draw generalizations from the results which are valid for other cases, they provide us with valuable information on the relationships between certain conditions. Furthermore, they can help point to gaps in the literature and stimulate further research. This is also an argument given by Wellington and Szczerbinski:

*'Case studies derived from research can be of great value in teaching and learning; case studies can lead into subsequent quantitative research by pointing to issues which can or should be investigated over a wider range; they can also follow on from a broader survey or quantitative approach by exploring a phenomenon in greater depth, in a more exploratory, explanation-seeking fashion' (Wellington & Szczerbinski, 2007, p. 93).*

Furthermore, they argue that case studies are a good way to transfer knowledge to the reader, because it is easier to relate to the problem. They state that the 'ability to relate to a case and learn from it is perhaps more important than being able to generalize from it' (ibid, p. 95).

### **1.3.2. Selection of cases: Dakar and Amsterdam**

This paper makes a comparison between the two cases of Dakar and the Amsterdam. These cases are selected, in order to show differences and similarities in urban agriculture in the global South and North. In order to remain within the limits of this paper without compromising in-depth research, only two cases are chosen. Dakar is the capital of Senegal, a low-income country which definitely falls under the category of countries in the South. Amsterdam is the capital of the Netherlands, a high-income country which fall under the category of countries in the North. This case study will not only provide the reader with more information on urban agriculture of the two countries but also with interesting differences and/or similarities between the global South and North.

### **1.3.3. Data**

In order to remain within the limits of the research, this paper makes use of existing literature on sustainability and both cases. In the case of Dakar, where urban agriculture already performs an important economic task for a longer time, continuous research has been done by local organizations, the ministry of agriculture, as well as by the Food and Agricultural Organization of the United Nations. The case study on Dakar is therefore based on the data which are retrieved from research reports. In the case of Amsterdam, many urban agricultural initiatives have their own websites with information on their activities. In addition, this paper makes use of research and policy reports by local, municipal and national organizations.

### **1.3.4. Operationalization**

The aim of this paper is to examine the extent to which urban agriculture contributes to the sustainability of Dakar and Amsterdam. Therefore, the concept of urban sustainability has been explained earlier in this chapter. It refers to the ability to meet the needs of current and future generations of urban residents, and is composed of economic, social and environmental criteria. In order to assess these criteria, a number of sub criteria have been determined, which are applied to the cases of Dakar and Amsterdam. Therefore, the practical part of this paper is structured as follows:

First, it discusses the case of Dakar. In order to gain a better understanding of Dakar and its role in the country, a general introduction to Senegal is given. Then, the paper elaborates on urban agriculture in Dakar and its characteristics. Second, it discusses the case of Amsterdam, which is structured in a similar way as the case of Dakar. After a general introduction to the Netherlands, it discusses urban agriculture in Amsterdam and its characteristics.

The sections that follow the introduction on urban agriculture in Dakar and Amsterdam deal with the analysis of its sustainability. As discussed above, it is necessary to distinguish between economic, social and environmental criteria. Therefore, both case studies are structured according to those criteria and their sub criteria. In order to assess economic sustainability, it looks at the relationships between urban agriculture and income, the labour market, access to land and water, and efficient use of inputs. As social sustainability is concerned, it looks at food security, equity between different social groups, health issues, and education. For the assessment of environmental sustainability, this paper examines the relationships between urban agriculture and air quality, water quality and management, soil quality, and the effects of use of pesticides and chemical fertilizers. In order to answer these

questions, it makes use of existing studies on urban agriculture in Dakar and Amsterdam which provides information on the sub criteria.

Together, these subcriteria constitute the extent to which urban agriculture contributes to the sustainability of the city. After having examined the contribution of urban agriculture to the sustainability of both cases, this paper highlights the most important similarities and differences in the conclusion.

## 2. Dakar

This chapter deals with the case study on Dakar. In order to understand the background against which Dakar is developing, it first gives a general introduction on Senegal. Furthermore, it gives an overview of the agricultural practices in the city. In addition, it discusses the economic, social and environmental issues which are related to urban agriculture. It concludes with an evaluation of urban agricultural issues which contribute or hinder urban sustainability of Dakar.

### *2.1. General introduction to Senegal*

Senegal is a West-African country at the Atlantic oceanic coast, with a surface of 196 722 square kilometres and a population of 13.8 million inhabitants (as estimated by the IMF in 2012). It belongs to the so-called SAHEL region, which consists of a geographical area stretched over the full width of the African continent, between the desert on the north and the savannas on the south. It has borders with Mauritania on the north, Mali on the east, and Guinea Bissau on the south. Furthermore, the Gambia is surrounded by Senegalese territory, as it lies between the areas of Kaolack and Ziguinchor.

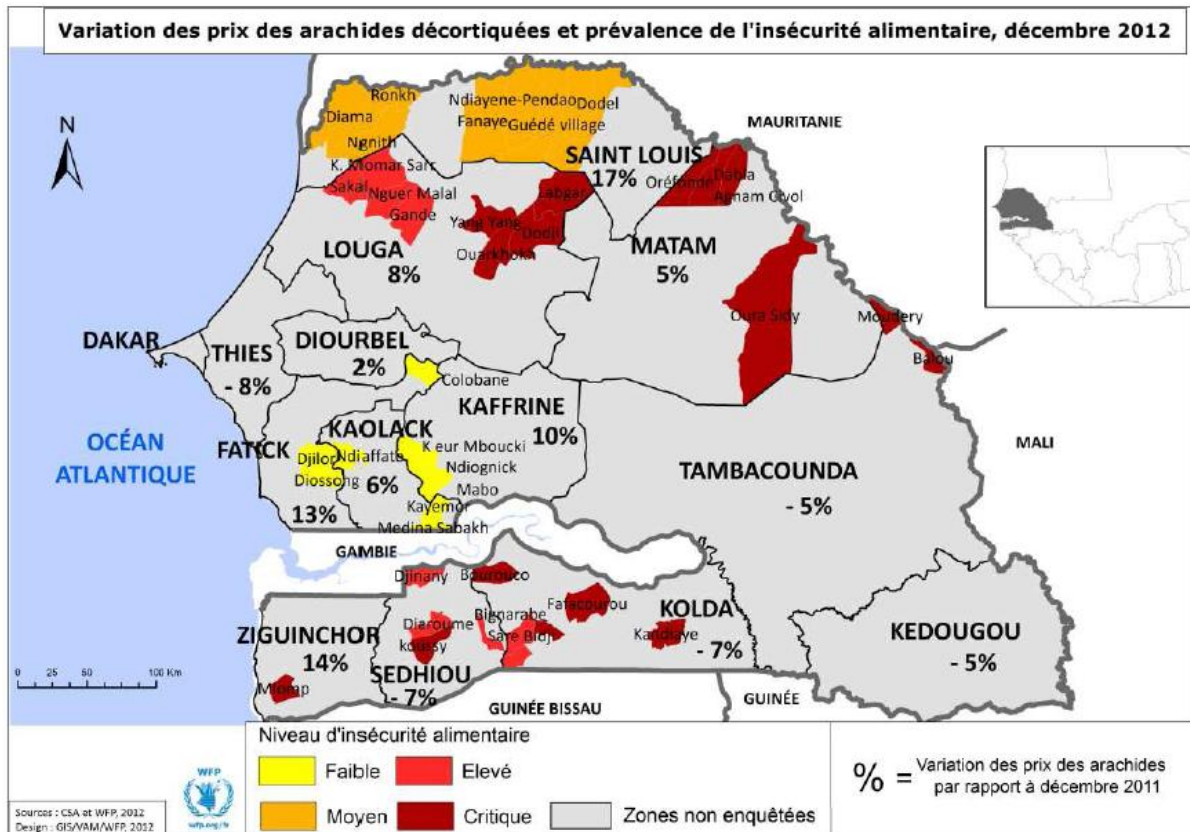
Senegal is a relatively flat country, with an altitude of 50 meters above sea level at 75 percent of the country's territory. It has a semi-arid tropical climate, with temperatures ranging between 20 degrees in winter and 35 degrees in summer. Furthermore, the climate is characterized by two main seasons: a dry season from November till May, and a hot monsoon season from June till October. The magnitude of precipitation, however, differs among the different regions. Whereas the north has an annual precipitation rate of less than 300 mm, the south has a rate of more than 1000 mm. Therefore, the country is divided in three main bioclimatic zones: forest in the south, savannah in the centre, and desert in the north.

For a long time in the 19<sup>th</sup> and the 20<sup>th</sup> century, Senegal was under French colonial rule. It gained its independence in 1960; the same year that Léopold Senghor became Senegal's first elected president. The country has been praised for its democratic multiparty system, in contrast to political systems of other African states. Furthermore, it is characterized by a long tradition of decentralization. In Senegal we can distinguish between three different levels of local governance: regions, communes and rural communities. In the region, it is quite unique that local governments have such a wide range of competences as in Senegal. In 1996, a number of laws strengthened the powers of local governing levels, by granting them the right to draft, program and implement policies which deal with economic development,

education, and other social and cultural issues, if these are in the regional, local or rural interests. As will be explained in one of the following sections, local governments play an important role when it comes to the security of land rights, which is essential for urban farmers.

When it comes to security, Senegal is relatively stable compared to its African counterparts, despite a number of conflicts in the region of Casamance, where separatist movements continue to cause tension between two ethnic groups. Even though the political situation is better than in many other countries on the African continent, Senegal still belongs to the group of countries that are underdeveloped. According to the Human Development Index from the United Nations in 2011, Senegal has been ranked 155<sup>th</sup> out of 187 countries and its human development is considered low. In comparison with other countries, Senegalese life expectancy is low, as well as the years of education and Gross National Income.

One of the major issues is food insecurity, which is prevalent in several regions of the country. The figure below indicates the presence and severity of food insecurity in 2012 in different regions of Senegal. The regions where the research has been done are marked with the colours, which indicate the level of food insecurity. The results ranged from weak (yellow) to average (orange), high (red) and critical (dark red). Furthermore, a study from the United Nations World Food Programme showed that in 2012, 810.000 people of the Senegalese population were hungry (WFP, 2012b).



**Figure 1. Food insecurity in Senegal.** Source: WFP. (2012a). *Bulletin Mensuel sur l'Evolution des Prix aux Senegal*. World Food Programme.

Except for levels of food insecurity, the figure also shows variations in price of ground-nuts. Rising food prices are a major source of concern when it comes to food security in many African countries, including Senegal. Although the country is the largest producer of salt in the region and it produces substantial amounts of peanuts and vegetable oil, it remains unable to feed its population. Therefore, it is reliant on imports of food products from other countries. The country is importing more than it exports and faces a trade deficit each year. The tables below show the most important products which are exported and imported and their trade volume. Clearly, Senegal is importing twice as much as it exports when we take a look at the value of the sum of all commodities. Furthermore, the first table shows that the main exported products are oil, diphosphorus pentoxide, cement, gold and fish. Among the imported products, we find oil and motor vehicles, but also many food products such as rice, wheat and dairy.



**Table 3: Top 10 export commodities 2008 to 2010**  
(Value in million US\$)

HS code	4-digit heading of Harmonized System 2007	Value (million US\$)			Unit value				SITC code
		2008	2009	2010	2008	2009	2010	Unit	
All Commodities.....		2 170.5	2 017.4	2 161.1					
2710 Petroleum oils, other than crude.....		729.4	434.9	503.4	0.9	0.7	0.7	US\$/kg	334
2809 Diphosphorus pentaoxide; phosphoric acid.....		220.0	148.1	199.0	1.4	0.6	0.7	US\$/kg	522
2523 Portland cement, aluminous cement, slag cement.....		123.4	149.8	201.5	0.1	0.1	0.1	US\$/kg	661
7108 Gold (including gold plated with platinum).....		21.3	181.2	205.0	11.4	21.8	24.6	thsd US\$/kg	971
0302 Fish, fresh or chilled, excluding fish fillets.....		79.7	86.9	78.0	4.0	5.5	9.9	US\$/kg	034
0303 Fish, frozen, excluding fish fillets and other fish meat of heading 03.04.....		54.6	63.1	71.6	1.2	1.2	1.1	US\$/kg	034
0307 Molluscs, whether in shell or not.....		49.1	49.9	42.6	4.0	4.0	4.4	US\$/kg	036
2402 Cigars, cheroots, cigarillos and cigarettes.....		30.7	41.4	45.4	10.8	11.7	16.3	US\$/kg	122
1508 Ground-nut oil and its fractions.....		17.7	38.5	57.8	1.4	1.2	1.2	US\$/kg	421
2104 Soups and broths and preparations therefor.....		28.3	39.8	44.6	2.5	2.6	2.4	US\$/kg	098

**Table 2. Senegal Top 10 export commodities.** Source: UN Comtrade. (2010). *Tradeprofile Senegal*. United Nations Statistics Division.

**Table 5: Top 10 import commodities 2008 to 2010**  
(Value in million US\$)

HS code	4-digit heading of Harmonized System 2007	Value (million US\$)			Unit value				SITC code
		2008	2009	2010	2008	2009	2010	Unit	
All Commodities.....		6 527.6	4 712.9	4 782.2					
2710 Petroleum oils, other than crude.....		869.2	560.0	829.4	0.9	0.5	0.7	US\$/kg	334
2709 Petroleum oils and oils obtained from bituminous minerals, crude.....		768.6	391.8	451.2	0.8	0.5	0.7	US\$/kg	333
1006 Rice.....		646.2	326.9	289.5	0.6	0.4	0.4	US\$/kg	042
8703 Motor cars and other motor vehicles principally designed for the transport.....		181.9	143.2	145.0	20.5	27.5	thsd US\$/unit		781
1001 Wheat and meslin.....		158.1	110.9	127.3	0.4	0.3	0.3	US\$/kg	041
3004 Medicaments (excluding goods of heading 30.02, 30.05 or 30.06).....		127.8	122.8	125.8	20.3	21.3	19.9	US\$/kg	542
0402 Milk and cream, concentrated or containing added sugar.....		122.1	115.3	104.0	4.3	2.5	3.2	US\$/kg	022
8517 Electrical apparatus for line telephony or line telegraphy.....		98.9	118.6	85.5					764
7213 Bars and rods, hot-rolled, in irregularly wound coils.....		125.7	70.8	86.4	0.9	0.5	0.6	US\$/kg	676
2711 Petroleum gases and other gaseous hydrocarbons.....		114.1	70.8	88.9	0.9	0.6	0.8	US\$/kg	343

**Table 3. Senegal Top 10 import commodities.** Source: UN Comtrade. (2010). *Tradeprofile Senegal*. United Nations Statistics Division.

Like many other developing countries in Africa, Senegal has experienced an explosion in urban growth over the past decades. Whereas the urban population in 1960 amounted to only 25 percent of Senegal's total population, this number has now increased to around 42 percent. The increase in urban population can mainly be attributed to massive migration from rural to urban areas. Urban growth at such a high rate imposes a number of challenges: growth in the economic and social sectors of the cities could not keep up with the increase of population. Therefore, urban dwellers faces many problems related to living, transport, education, health, etc. Often, migrants establish informal settlements within the urban area. However, there is a lack of public services, such as access to water, public transport, sewage and garbage collection (ONU-HABITAT, 2008, p. 5).

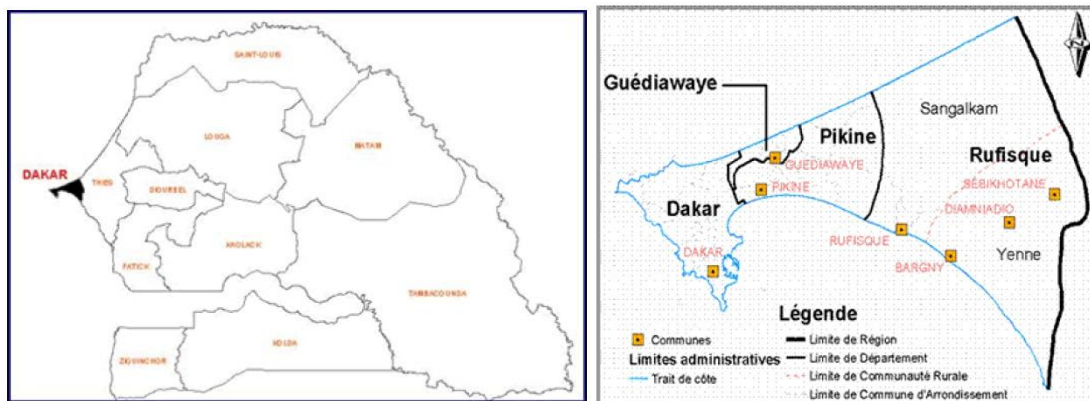
Urbanization also leads to environmental problems, due to the incapability to deal with excessive waste. Furthermore, the expansion of (informal) settlements in urban areas

occurs at the costs of green spaces. Moreover, an increase in transport results in higher pollution and worsening of air quality. Another problem in Senegal is water pollution, in coastal waters, rivers as well as groundwater. Especially the bay of Hann, which surrounds the industrial area of Dakar, is heavily polluted (ibid).

## 2.2. Urban agriculture in Dakar

In general, the Senegalese agricultural sector consist mainly of production of non-food crops such as peanuts and cotton, food crops such as millet, sorghum, corn and rice and horticulture. Agriculture in Senegal is increasingly performed in urban and peri-urban areas: the bioclimatic conditions are favourable and the markets are growing because of rapid urbanization. As mentioned before, around 42 percent of Senegal's population resides in urban areas. Dakar, the capital, covers around 20 percent of Senegal's total population. Furthermore, the city lies in de zone of Niayes, the region of Senegal where a large part of the country's agriculture is concentrated. Therefore, the paper will concentrate on agriculture in the urban and peri-urban areas of Dakar.

The Dakar region is situated at the most western part of Senegal at the Cape Verde peninsula and is subdivided in 4 departments ((Dakar, Guédiawaye, Pikine and Rufisque), as illustrated by the maps below.



**Figure 2. Dakar Region.** Source: FAO-CRDI. (2006). *Étude de cas sur les organisations de producteurs urbains à faible revenu: le cas de Dakar (Senegal)*, p.9 – 10

Temperatures vary around 24 degrees, with minimum of 14 degrees in January and 35 degrees in October. As in the other parts of Senegal, there is a dry season from October/November till May and a wet season during June, July and August. Lying at the coast, the climate of Dakar is mitigated by trade winds from the ocean which are caused by the anticyclone of the Azores. The zone of Niayes consists of dunes and wetlands, which are

characterized by low fertility and low levels of silt and organic matter (FAO-CRDI, 2006, p.9 – 11).

The scale of agriculture in Dakar and its surroundings is enormous: for example, the region contributes for more than 30 per cent to the national production of fruits and vegetables (ibid, p.5). The vegetables which are most common among the producers in Dakar are lettuce, jaxatu (a type of eggplant) and tomatoes. Especially lettuce is popular: 98 per cent of the urban farmers cultivate this crop. 85 percent of the farmers produce tomatoes and 83 percent produce also jaxatu. Among secondary crops, the following can be found: onion, cabbage, eggplant, okra, carrot and mint (Gaye & Niang, p. 18). Furthermore, some farmers have trees such as moringa, mango, papaya or lemon. It is estimated that around 70 to 80 per cent of the consumption of fruits and vegetables by the households in Dakar is provided by urban agriculture (Arku et al., 2012, p.8). The urban farmers work continuously, regardless of the seasons: the average number of months of work lies between 10 and 12 months per year. 73 per cent of the farmers work throughout the year. Among farmers which make use of waste water irrigation, this percentage is even higher: 99 per cent. Only 4.2 per cent of the urban farmers do not work during the monsoon or hot season (ibid, p. 41). Interestingly, most of the farmers are men. Women rarely work on the champ, but instead they are selling the products.

In addition to the quite traditional activities in urban agriculture, another farming technology can be found in Dakar: micro-gardening. This technique has been introduced in 1999 by the FAO through a project, which aims at alleviating poverty and fighting malnutrition. Micro-gardening is a technology which can be used to produce fruits and vegetables on any vacant place in the city, such as gardens or roofs. Thus, residents in the city who do not have access to agricultural land are able to cultivate their own fresh crops. Moreover, micro-gardening can be performed by any social category: ‘the poor as well as the rich, men and women, young and old people, valid and handicapped persons’ (UN Habitat, 2008). Furthermore, the people who make use of micro-gardening are stimulated to reuse waste materials such as peanut shells and rice chaff. According to a report by UN Habitat, more than 4000 families participate in the project (ibid).

### ***2.3. Economic sustainability***

#### **2.3.1. Urban agriculture and income**

Being the capital and biggest city of Senegal, Dakar inhibits the majority of Senegal's urban poor. For those, urban agriculture is often a first step to improvement of their life situation. However, the gains from urban agriculture highly differ. There are several areas in Dakar where urban farmers have their plots, and research had shown that in certain areas the gains from sales are higher than in others. For example, the average daily profit of a farmer in central Dakar is 417 F per day, which amounts only to roughly 40 per cent of the poverty line of 1000 F a day. In the area Patte d'Oie, the profits are even lower: 173.2 F. The profits of the farmers in the area Ouakam are significantly higher: 984 F per day (FAO-CRDI, 2006, p. 69). Around 55 per cent of Dakar's urban farmers does not have other employment, and are thus fully dependent on their agricultural produce. It is difficult, however, to obtain exact and reliable information about the profits which urban farmers make. First of all, most of the farmers do not keep a record of their expenses and sales. And second, they are reluctant to give information about their profits, out of shame or out of fear for competitors. Nevertheless, they report that urban agriculture is an important source of (indirect) income. 96.7 per cent of Dakar's urban farmers indicate that they use the revenue from their produce for their own nutrition, school fees for their children, healthcare and investment in their farms (Gaye & Niang, 2010, p. 23).

#### **2.3.2. Labour market**

The previous section showed that urban agriculture is an important source of income for many families, because it provides them with food and extra income. It creates employment for people who have poor skills and credit. In addition, it spontaneously fosters the creation of jobs in related sectors. Urban farmers are dependent on metalworkers and smiths for the construction of agricultural tools. Furthermore, they need organic materials such as manure, peanut shells, fish-waste and other fertilizers. Therefore, new markets are created for the recycling and sales of waste products. Moreover, these materials need to be transported from one place to the other, which means that an increase for the demand of these materials, the demand for transporters also rises (Gaye & Niang, 2010, p. 16). Thus, it stimulates parts of the services sector, such as vehicle rent and drivers. Moreover, if not all crops are for domestic use, the rest can be sold. Here lies an important task for the women, who bring and

sell the products on local markets (FAO-CRDI, 2006, p.16). In the case of a family, it is usually the spouse of the farmer who takes care of the transportation to the markets and the sales. Alternatively, male farmers sell their products at their fields to women who will resell it at the markets. In both cases, the women play a key role (ibid, p. 38). Thus, urban agriculture creates employment in different sectors and for different social groups.

### **2.3.3. Access to land and water**

The region of Dakar is not the optimal place for agriculture: the soil is relatively poor and the groundwater too saline. Furthermore, the increasing growth of the urban population increases the demand for space for settlement. During the last decades, a significant part of land which could be used for agriculture has been lost due to expansion of the urban area (Gaye & Niang, 2010, p. 53). However, the case of urban agriculture in Dakar shows inventive solutions to some of these problems.

Instead of using groundwater, most urban farmers make use of waste water. They have the advantage of being close to the city, where waste water is readily available. Furthermore, the use of waste water increases the yield. Studies have shown that vegetables which are irrigated with waste water grow faster, become bigger and have a better taste. For example, crops such as cabbage, jaxatu and lettuce are significantly more voluminous when irrigated with waste water. Furthermore, it takes only 20 to 25 days to grow lettuce, instead of one month (ibid, p. 44-45). Consequently, farmers can produce more and better quality products. However, as will be discussed more in depth in the section on environmental issues, waste water use imposes a number of risks related to hygiene.

Moreover, a problem which is limiting farmers is the insecurity with regard to land use. As discussed before, Senegal has been under French colonial rule for a long time. During that period, the French civil code and Senegalese customary law existed alongside each other. In 1964, however, the Senegalese government introduced a different system, in order to stimulate agricultural productivity. They passed the 'National Domain Law', which was intended to reduce the power of ethnic and religious traditions and hierarchies which influenced the access to land. According to this law, around 97 per cent of the total land was classified as 'National Domain', which is owned by the state. Around 2 to 3 per cent of the land which was registered as freeholds under colonial rule remained privately owned. Furthermore, the law 'classified land as within urban, classified, agricultural, or pioneer zones' (USAID, 2010, p. 5). Urban zones fall under the authority of municipalities. Classified zones are areas with a special function such as 'classified forests, national parks, and other

government protected areas' (ibid, p. 7). Agricultural zones are under the authority of rural councils. Pioneer zones consist of land that does not fall under one of the other categories and are under control of the central government.

There are several problems related to this system of land rights. The law allows the rural councils to determine how agricultural land is allocated according to customary principles. The only condition is that the land is used productively. The latter, however, is also subject to the opinion of the rural councils on productive use. Rural councils therefore have a lot of discretion when it comes to land allotment. Generally, using land to keep livestock or forest management is seen by the councils as less productive than intensive crop cultivation (ibid, p. 8). The risk of losing their plots puts farmers under pressure to produce according to the wishes of the rural councils rather than according to their own needs. Moreover, intensive cultivation of land results in higher degradation of the land and thus lower profits in the longer term. Although officially land can only be inherited if the heirs send a request to the rural council, inheritance is common and often occurs (Hesseling, 2009, p. 261). However, this does not apply to women, who can access land only through marriage or their natal families. Although national law should ensure equal rights for men and women, customary principles prevail, which put women in a disadvantaged position. In the cases that there is land available for divorced women and widows, it is often of poor quality (USAID, 2010, p. 9). In the urban areas, which are controlled by municipalities, it is possible to be granted 50-year surface rights when you are a resident. Nevertheless, informal settlements account for about one third of urban land (ibid, p. 8).

In order to obtain freehold rights of land, it is necessary to register them. However, this is a costly and time consuming procedure. Furthermore, a lack of knowledge and a high illiteracy rate obstructs landholders from registering their lands (ibid, p. 9). Urbanization and a higher demand for agricultural lands form a challenge to the security of land rights of both urban residents and rural landholders which are located nearby urban areas. Hesseling points to the consequences of weak land rights in combination with a higher demand for land in the region of Dakar:

*'Although the law expressly forbids the selling of land in the national domain, an active land market occurs in areas where new dynamics of land tenure are triggered by the process of urbanisation. This is for instance the case in the Niayes region. The coastal Niayes is a unique ecological zone stretching from Dakar to Saint-Louis with rich soils particularly favourable for horticulture. The area is characterised by high population*

*density as the result of natural growth and increased migration flows. Especially near Dakar, purchasing land has long been a common phenomenon. Buyers purchase land directly from village chiefs and the traditional 'owners' of the land. Many of them are so called 'Sunday farmers': civil servants and merchants living in the capital and producing mangos and citrus fruit as a supplementary income. Since such transactions are illegal, it is hard to evaluate the actual number of sales.'* (Hesseling, 2009, p. 263).

Thus, especially farmers in urban and peri-urban areas face a high degree of uncertainty when it comes to land rights. Even in the cases where farmers have obtained freehold rights, there is still a possibility of expropriation by the government. This is permitted by national law under the condition that the land is expropriated because of public necessity. For instance, municipalities can appeal to these rights and expropriate land in rural areas, in order to accommodate the expansion of the city. Although it is required by law that the holders of land should be compensated in the form of upgraded or alternate land, the compensation is often not satisfactory (USAID, 2010, p. 11).

For farmers who face a high degree of insecurity with regard to land rights, it is not attractive to invest in long-term improvement of their plots. As pointed out by De Soto and Cheneval, 'secure land tenure among the urban poor can grant the much needed legitimacy to urban farming. Efforts to achieve this type of land tenure structure can contribute to more productive and ecologically sustainable use of agricultural land and facilitate the use of land as property or collateral for transactions to increase farmers' access to credit' (de Soto and Cheneval, 2006, in: Arku et al. 2012, p. 14).

The insecurity of continuous access to land is not the only issue which limits farmers in the development of their business: in order to set up a business or family farm, it is necessary to invest in the preparation of the plot, seed, agricultural tools, fertilizers and pesticides. Most of the tools are inexpensive: the equipment of an urban farmer typically consists of simple tools such as watering cans, hoes, trimming and ploughing tools (Gaye & Niang, 2010, p. 39). Furthermore, urban farmers save on costs for fertilizer by using waste water for irrigation, which contains useful fertilizing elements (ibid, p. 27). However, 91 percent of the urban farmers finance their business from their own funds: they barely receive subsidies and do not have access to credits (ibid, p. 23). The banks do not have confidence in the projects of farmers and are therefore very careful giving out loans. Therefore, urban agriculture is less accessible to the poorest of Dakar.

In 2008, however, the Senegalese government started a programme to improve the productivity of the agricultural sector. President Abdoulaye Wade initiated this programme with the aim of making Senegal self supporting in agricultural products by 2015. The programme ‘Grand Agricultural Offensive for Food and Abundance’ (GOANA) involved farming subsidies and distribution of tools and seeds, in order to increase agricultural productivity. Although production increased during the years that followed, it is unclear whether this increase can be attributed to the GOANA programme. The weather conditions were also more favourable, which might explain the increase in harvest. However, as a response to the GOANA programme, the Senegalese private sector also invested more in agriculture (Ministère de l’Agriculture, 2010, p. 18).

More attempts to help poor residents of Dakar to start up a business include micro-financing. A micro-financing institute was created, in order to help the poor to start a business and improve their economic situation by giving them credit which they could use for agricultural investments. Most of the credited projects are horticultural projects. However, the amount of money is usually small and not sufficient to finance the required inputs for urban farming (ibid, p. 32).

Micro-gardening can be an alternative for those who do not have the financial or social means to start farming on a plot. It can be performed on a very small scale, on rooftops, balconies or small backyards and the work is lighter than plot farming. Therefore, it is more suitable for women, older people and physically handicapped persons. Micro-gardening is a special technique which makes it possible to grow vegetables without soil. Instead, the farmers use solid substrates such as peanut shells, rice chaff or laterite.

### **3.3.4. Efficient use of materials**

In comparison with their rural counterparts, urban farmers have the advantage of living in a diverse environment with a large supply of different products and materials. Although the soil in and around Dakar is not optimal for farming, it can be made suitable for cultivation when using the right materials. The farmers improve the quality of the soil by adding organic material, which can be made from different products. Hereby, they reuse several materials such as peanut shells, fish waste, manure, which would otherwise not be used and would need to be removed. Furthermore, for the production of agricultural tools, other materials are reused such as old car pieces.

Instead of using groundwater, most urban farmers make use of waste water. They have the advantage of being close to the city, where waste water is readily available. Furthermore,



the use of waste water increases the yield. Studies have shown that vegetables which are irrigated with waste water grow faster, become bigger and have a better taste. For example, crops such as cabbage, jaxatu and lettuce are significantly more voluminous when irrigated with waste water. Furthermore, it takes only 20 to 25 days to grow lettuce, instead of one month (ibid, p. 44-45). Consequently, farmers can produce more and better quality products. Moreover, by using waste water, the farmers can save on expenses for fertilizers. They use 50 percent less of NPK fertilizer (a fertilizer composed of nitrogen, phosphor and potassium), 25 per cent less of urea and 40 per cent less of manure (Guèye, 2010, in: ibid, p. 38). However, as will be discussed more in depth in the section on environmental issues, waste water use imposes a number of risks related to hygiene.

Furthermore, the preservability of certain crops is limited and according to the urban farmers, crops which are irrigated with waste water perish even faster. Lettuce, for example, should be sold on the market within 24 hours (ibid, p. 45). Although urban farmers have the advantage of being close to the market, which limits the cost and time of transportation, preservability of their produce is still an issue. In addition, there is no organized system which limits eventual surpluses or shortages. Many farmers produce the same the crops, and at certain periods in the year this leads to high surpluses, price falls and losses due to the fact that not everything is sold (FAO-CRDI, 2006, p. 19).

## ***2.4. Social sustainability***

### **2.4.1. Food security**

As discussed before, a large part of Senegal's population faces hunger. According to research done by the Senegalese ministry of Agriculture (Ministère de l'Agriculture, 2010), around 30 percent of the population does not reach the minimum intake of calories of 2400 per person per day, a standard set by the Food and Agricultural Organization of the United Nations. Senegal is heavily dependent on imports of food products such as rice. Therefore, the country is vulnerable to price rises on the world market. This has become ever more clear during the last years, during which the world market experienced an explosion of food prices and Senegal faced higher difficulties to feed its population.

Urban and peri-urban agriculture in Dakar is a welcome and necessary addition to the rural agricultural products and imports. Fruits and vegetables are suitable crops for urban farming and provide urban households with important vitamins and minerals. Furthermore, many crops can be produced throughout the year, ensuring a constant supply of fresh products. Staple crops such as grains, however, are not suitable for urban farming as they

require large spaces for their cultivation. They are an important element of the diets of urban dwellers, but for their supply, Dakar will remain dependent on rural or foreign produce. In contrast to fruits and vegetables, they do not perish easily and can be transported over a greater distance and longer period of time without getting spoiled. Furthermore, they are usually less expensive than fruits and vegetables and therefore more affordable to buy on the market. Nevertheless, the dependence on imports for staple foods remains a weakness in the food system of Dakar.

### **2.4.2. Equity**

For a sustainable present and future, it is important that there is equity not only between generations but also within. Although urban agriculture seems to contribute to a better income and food security in Dakar, it is questionable whether every social group benefits from it. For example, if we look at gender relations, we have already seen that men have access to land more easily than women. For divorced and widowed women, it is difficult to stand up for their rights, because of traditional customs which are deeply rooted in the Senegalese society. Furthermore, the work of the field is hard physical work and therefore more suitable for men. Nevertheless, women report that they also benefit from urban agriculture, even if they are not involved in farming as such. Instead, they are selling the products on local markets and generate income for themselves and their families. Furthermore, the micro-gardening project which was initiated by the FAO has a number of advantages for women: if they do not have access to land, they can use roofs or balconies instead and the work is less hard physically. Therefore, micro-gardening is more popular among women.

Furthermore, we have seen that poor people are affected more by insecure land rights. First of all, the illiteracy rate is higher among poor people, which makes it more difficult for them to be informed about their rights and eventual procedures. Second, it is a costly and time consuming procedure to register land and obtain freehold rights. Third, they become easily victims of expropriation, either because of government decisions or because of informal transactions between entrepreneurs and rural councils. Moreover, the poorest people do not have the required means to start farming. They do not have enough savings and they are not eligible for credits, because banks do not have enough guarantees that they will be able to pay back their loans.

### **2.4.3. Health**

Standards are set for a minimum intake of calories per person per day, namely 2400 calories. In addition to the quantity of nutrition (e.g. a minimum intake of calories per person per day),

it is necessary to take a look at the quality and diversification of the diets of the Senegalese. Even if a person reaches the minimum standard of the FAO of 2400 calories, he can still be undernourished due to a lack of vitamins or minerals. Deficiencies in iron, zinc or vitamin A make the human body more vulnerable to infectious diseases. Malnutrition is especially dangerous for pregnant women and children. Moreover, in times of food scarcity, people are tempted to use food products which are spoiled. Consequently, bacteria in these products impose a threat to health in the form of diseases and infections.

Urban agriculture can help diversify the diet of the urban population, increasing the intake of essential nutrients. A better diet contributes to better overall health, but can also help to fight HIV/AIDS. According to Arku et al. 'Enhanced food security in these households can also contribute to increased adherence to HIV/AIDS treatment' (Arku et al., 2012, p. 8) Local and fresh produce provide people and their families with better quality products, provided that they are produced in a safe and hygienic way. As will be discussed in further depth in the section on environmental sustainability, the extensive use of pesticides imposes a serious risk to the health of the farmers and consumers of the products.

Furthermore, although the use of wastewater seems a promising and environmental friendly alternative to the use of ground water, there are certainly risks that come along. A research which was conducted in Pikine in 2000 showed that at least 41 per cent of the farmers who used wastewater for their agricultural practises were infected by intestinal parasites. However, when they were asked about the content of wastewater, the majority responded that it is a useful fertilizer. Merely 24 percent of the interrogated farmers said that the waste water could contain germs and parasites. Furthermore, only 26 percent of the farmers reported illnesses related to the use of waste water. Generally, they were more concerned about the risks of pesticide use. Clearly, a large part of the farmers were unaware that they were infected with parasites. After treatment, however, they reported a sense of higher well being (ibid, p 66).

This research illustrates the lack of information. Many of the farmers are not well informed about risks related to pesticides and waste water use. When they are asked what the possibilities are to reduce the risk of illness, the most common responses are adequate use of pesticides, changing methods of irrigation and reduction of time spent on the field. Although they spent on average more than three hours a day on water irrigation, the majority does not use protective gloves, boots or masks. In addition, some of them do not wash their hands after irrigation or eat fresh produce at the field without disinfecting it (ibid, p. 75). Moreover, the

bacteria in waste water used for irrigation does not only impose a risk to the health of the farmers themselves, but also to the distributors and consumers.

#### **2.4.4. Education**

The previous section showed how a lack of information affects the health of urban farmers, distributors, sellers and consumers negatively. One of the reasons for the lack of information is a low level of education among the farmers. Only 39 per cent of the farmers are educated, of which 2,4 % percent have higher education, 4,9 percent secondary education and 31,7 percent only primary education (Gaye & Niang, 2010, p. 64-65). Most information is transferred through personal relationships. The small scale agricultural farms are usually family businesses, in which the younger generations learn from the older ones. In addition, people share knowledge with friends and neighbours, thus learning from each other. Furthermore, input suppliers such as those of pesticides provide farmers with information. And last, educational programs organized by the government or NGOs are a source of knowledge.

On the one hand, good education is a prerequisite for well functioning and safe urban agriculture. On the other hand, urban agriculture can help to improve the educational level of urban farmers and their families. The income which is generated by the cultivation of crops is often used for school fees of the farmer's children. Furthermore, a balanced diet helps children to concentrate at school.

The Niayes zone is an attractive zone for agricultural activities. This does not only attract farmers but also organizations which do agricultural research. A number of organizations which are active are the Senegalese Institute of Agricultural Research (ISRA), the Centre of Professional Horticultural Education (CFPH), the Food and Agricultural Organization of the United Nations, and several NGOs such as Aquadev, Enda and SOS Sahel. The large number of organizations which are involved in agricultural research serves as a pool of knowledge for the urban farmers.

### ***2.5. Environmental sustainability***

#### **2.5.1. Air quality**

Dakar is a congested city and most cars are old cars on diesel which are imported from Europe. Clearly, these are not the most environmental friendly vehicles. Furthermore, the infrastructure in the city is not sufficient to accommodate the large number of cars.

Consequently, the traffic is often stuck in the city which results in even higher emissions. In combination with a high degree of dust, the air quality in Dakar is therefore low. The benefits of plants in relation to air quality are well known: they absorb CO<sub>2</sub>, their foliage can hold particulate matter and they can reduce the temperature within the city. Therefore, it can be suggested that urban agriculture has a positive effect on the air quality of Dakar. However, due to a lack of data, the extent to which urban agriculture contributes to a better quality of the air is not clear.

### **2.5.2. Water quality and management**

The majority of the urban farmers cannot afford to use drink water for their crop cultivation. Dakar borders the ocean, but this saline water is not suitable for farming either. Only 6 per cent of Dakar's waste water is treated, and is resold after purification close to the purification stations. Therefore, the majority of urban farmers are dependent on non treated waste water for irrigation of their champs (Ministère de l'Agriculture, 2010, p. 31-32). On the one hand, the use of waste water helps relieve pressure on the scarcity of drinking water. Furthermore, it contains useful minerals which enable farmers to use less fertilizers and manure, saving costs. Moreover, waste water is used to refill water surfaces close to the ocean, in order to prevent saline water from pushing inwards (Gaye & Niang, 2010, p. 46). On the other hand, as the section on health has shown, waste water imposes a sanitary risk.

### **2.5.3. Soil quality**

The use of waste water imposes a sanitary risk in terms of the health of the farmers and other people who are involved in the production or distribution process. Therefore, one might also question the effects of waste water on the quality of the soil. The water which is used for irrigation usually contains a mix of different types of salt. The concentration of salt in the soil, however, is often found to be much higher. Depending on the ability of the soil to drain away these salts, different levels of salinity are found in different types of soil. When the salinity of the soils becomes too excessive, it affects the returns of farming. Gaye and Niang found that compared to surface water or water from wells, waste water contains the lowest level of salt on average, and that although seasonal peaks of salt concentration in the soil occur, it is still manageable (Gaye & Niang, 2010, p. 51). Nevertheless, waste water contains germs which contaminate the soil and products, and depending on where the waste comes from it can contain chemicals which affect the concentration of minerals of the soil (FAO-CRDI, 2006, p. 19).

Furthermore, the expanse of the city imposes a challenge to the availability of land for agriculture. This puts constraints on the soil because farmers are trying to produce more on plots of the same or smaller size. According to a report by the Senegalese Ministry of Agriculture, the production of vegetables has increased from 450.000 tonnes in 2007 to 555.000 tonnes in 2009, and the production of fruits from 165.000 tonnes in 2007 to 195.00 tonnes in 2009, whereas the surface of cultivated land has remained the same (Ministère de l'Agriculture, 2010, p. 18). This means that farmers have started to use their lands more intensively. Although part of this increase can be attributed to a better use of materials, techniques and other conditions, it is worrisome that much attention is given to the increase of productivity. In the long term, intensive cultivation will lead to more land degradation and lower profits.

However, urban farming also has a positive effect on the soil of Dakar. In some areas of the Dakar region, the soil is protected from erosion by cultivation. Mbaye and Moustier (2000) argue that due to that fact that 'most of the farming areas are located in depressions and dune areas, the water is able to penetrate the soil, in contrast to the built-up areas, which are almost impermeable to water' (Mbaye & Moustier, 2000, p. 245). Because of urban farming, the cultivated areas are able to retain rainwater, which helps to prevent erosion. To give an example: 'the filao plantations between Cambérène and Guédiawaye have caused the rate of white dune-sand erosion to be reduced from 12 m to 2 m per year' (ibid, p. 246).

#### **2.5.4. Use of pesticides and fertilizers**

Generally, Senegalese farmers should follow the guidelines which are laid down in the CODEX Alimentarius, a document on internationally recognized standards, which was established by the FAO and WHO. In addition, they are advised to restrict their use of pesticides to those which are allowed by the Sahelian Committee on Pesticides (CSP). However, a lack of national legislation and control leads to utilisation of substances which are not authorized by the CSP and overuse of authorized pesticides (Ministère de l'Agriculture, 2010, p. 26). The total amount of pesticides used in the peri-urban agricultural areas of Dakar is estimated around 60 kg per hectare per year. Only two out of the 15 substances which are used are authorized by the CSP. The following pesticides are found to have contaminated the ground water, imposing sanitary risks: Carbofuran, Dimethoate, Ethoprop and Methomyl (Gaye & Niang, 2010, p. 40).

When it comes to the use of fertilizers, urban farmers of Dakar make use of organic fertilizer which is made from peanut shells, poultry excrement, industrial and fish waste

(Mbaye & Moustier, 2000, p. 245). Furthermore, they can significantly reduce their use by using waste water for irrigation. Waste water already contains essential fertilizing elements, which reduces the need for further fertilization. The disadvantage of this, however, is that waste water is usually not treated and therefore imposes serious risk to the health of farmers and consumers.

## ***2.6. Sustainability of urban agriculture in Dakar***

The previous sections have analyzed the economic, social and environmental issues which are related to urban agriculture and the sustainability of Dakar. Urban agriculture plays an important economic role in Dakar: although, a large part of it falls under the informal sector, it increases income and food security, it creates jobs, and it makes the city less dependent on imports. The increase in income allows families to spend more money on school fees for their children, which increases their chances for a better future. Furthermore, projects such as micro-gardening give women, older people and other weak social groups the chance to grow vegetables and improve their situation. Furthermore, urban farmers in Dakar benefit from the city's infrastructure, which enables them to shorten the way a products needs to undertake to get from the field to the consumer. This does not only leads to fresher products but also helps to save costs on packaging, conservation and transportation.

In addition to the economic benefits, urban agriculture also improves the health of Dakar's citizens by providing them with fresh produce. The short distance between the producers and consumers has the advantage that the products are of better quality. Improving the diet of the urban dwellers has a positive effect on their overall health and also helps fighting diseases such as HIV/AIDS. Another social benefit is that, although they are not doing physical work at the plot, women are involved as sellers of the agricultural products. Furthermore, micro-gardening gives them the opportunity to grow vegetables themselves.

When we have a look at environmental aspects, urban agriculture prevents soil degradation by helping the soil to retain water. Furthermore, plants have a positive effect on the air quality. Moreover, urban agriculture makes use of materials which would otherwise be wasted such as peanut shells, rice chaff, fish waste and poultry excrement. By using waste water, farmers are less dependent on NPK fertilizers, which are made from fossil fuels. Nevertheless, the use of pesticides, chemical fertilizers and untreated waste water affect the quality of water and soil.

The benefits of urban agriculture suggest that it contributes to a more sustainable future of Dakar. However, as we have seen, there are a number of issues which need to be improved. For example, in order for everybody to benefit from urban agriculture and ensure equality within the current generation, including the poorest and women, access to land, credit, and agricultural inputs needs to be improved. The current system of land rights imposes difficulties: first of all, the farmers and their families are affected personally and economically when they lose their land or when they have to move to a different plot. Second, the insecurity of land rights is a negative incentive, which discourages farmers to make long term investments in their plots.

Furthermore, urban agriculture can be beneficial to health, but only when the products are of good quality. This means fresh produce, but also clean produce. As the previous sections have shown, the use of waste water and pesticides negatively affect the health of the farmers, but also of the distributors, sellers and consumers. Furthermore, waste water, pesticides and chemical fertilizers also have a detrimental effect on the environment, by contaminating the soil and water. In order to be able to farm in the future, it is necessary to treat the natural resources carefully. To conclude the case study on Dakar, this paper argues that urban agriculture can contribute to a more sustainable future of the city, but only when attention is given to the economic, social and environmental constraints as mentioned above. Economically, urban agriculture makes an important contribution in terms of income and employment and socially to higher food security. However, the benefits are not equally distributed among different social groups due to institutional constraints and local traditions. Furthermore, although urban agriculture has potential to improve environmental quality, there is a lack of attention to the detrimental effects of chemicals and untreated wastewater. Therefore, urban agriculture contributes insufficiently to urban sustainability in Dakar.



### 3. Amsterdam

This chapter deals with the case study on Amsterdam. It first gives an introduction into the Netherlands and its agricultural sector, which enables us to understand more of the sustainability issues in the country and its capital. Furthermore, it discusses the current state of urban agriculture in Amsterdam by giving a number of examples of urban agricultural initiatives. It continues, by discussing the economic, social and environmental issues of urban farming in Amsterdam in relation to its urban sustainability. It concludes with an evaluation of urban agricultural issues which contribute or hinder urban sustainability of Amsterdam.

#### 3.1. General introduction to the Netherlands

The Netherlands is a Western European country, bordered by Germany, Belgium, and the North Sea. Although its surface of 41.543 square kilometres is relatively small compared to most of its European counterparts, it has a population of roughly 16.8 million inhabitants (CIA World Factbook, 2013). Therefore, it is one of most densely populated countries in Europe. However, only 33.893 square kilometres of the total surface of the country is land, the rest is water. Around 80 per cent of the population is Dutch, and there are a number of minorities from the Dutch Antilles, Indonesia, Suriname, Turkey and Morocco (ibid). It is a constitutional monarchy with a strong centralized national government. Although the country is divided in 12 provinces and 487 municipalities, the national government ensures uniformity in many areas, either through direct legislation or by incentives such as subsidies (Gupta, 2007, p. 136).

The Netherlands is famous for its landscape, which is characterized by wide fields, canals, windmills and dikes. The country has a long tradition of land reclamation, in order to make land available for agriculture and settlements. The Netherlands is a flat country: the highest hill, which is close to border with Germany and Belgium, is only 322 metres high. There are no mountains or other significant areas of wilderness which is not suitable for farming or settlement. The most serious challenge is water: especially in the north and the western part of the Netherlands, many areas are up to 5 metres below the sea level (Oenema et. al, 2005). The map shows these areas which are



**Figure 3. Areas of the Netherlands below sea level.** Source: Lamé, F. (2010). *Into Dutch Soils*. Ministry of Housing, Spatial Planning and Environment.

marked blue. As one can see, nearly half of the Netherlands lays below sea level. Nevertheless, a system of dikes, canals, ditches and water pumping stations has enabled the country to make and keep large areas dry. Interestingly, the Netherlands has an extensive agricultural sector, despite its population density and land scarcity. In 2011 there were 72.300 agricultural holdings, and 1.872.400 ha was used for arable farming or horticulture (EUROSTAT, 2012). According to a report by AgriHolland (2012), around 67,5 per cent of available land in the Netherlands in 2008 was used for agriculture, including land needed for livestock farming.

One of the reasons that agriculture is a profitable activity is the fertility of the soil. Along the coast from North to South, the Netherlands are protected by a range of sandy dunes. They protect the land from the sea and prevent salty water from mixing with the inland groundwater, which is used for agriculture. Next to the dunes, we can find the lands which were swamps before. These lands were previously covered with peat, which has been dug away during the centuries and has been used, among others, for fuel. Underneath the layer of peat, a layer of marine clay appeared. In the more central parts of the country, which is crossed by rivers, we find river clay and sandy soil areas. Especially the layers of clay have proven to be suitable for agriculture. Because of the availability of fertile soil throughout the country, agriculture is not restricted to specific areas but practised in every region (Lamé, 2010, p. 9).

Furthermore, the Netherlands has a moderate climate, which is influenced by its proximity to the sea. The winds which come from the sea ensure that the winters are mild and the summers relatively cool. Rainfall is common throughout the year, which is beneficial for livestock farming. However, there are not enough hours of sun to grow certain crops outside. Therefore, we can find many greenhouses in the Netherlands. Arable farming in the Netherlands consists mainly of growing of potatoes, sugar beets and cereals, and is relatively of minor importance on an international scale. Common fruits and vegetables which are grown outside are for example apples, pears, onions, different types of lettuce, cauliflower and asparagus (CBS statistics). In greenhouses vegetables like legumes, cucumber, tomatoes and capsicum and fruits like strawberries are more common (ibid). However, the Netherlands are probably most famous for their production of flower and bulbs. Whereas the cut-flowers are mainly grown in greenhouses, the bulbs are grown outside on the fields and provide spectacular colourful views in spring when they start to bloom.

The Dutch agricultural sector is one the most productive of agricultural sectors in the world (Zanden, 1997, p. 357). However, a large part of the production is exported to other

countries. The Netherlands is the second biggest exporter in the world (after the United States) of agricultural products. Furthermore, agricultural exports are an important contributor to the Dutch trade balance. The surplus of agricultural products (agricultural exports minus imports) in 2012 had a value of 25 billion euro (CBS, 2013). The total surplus of goods (all exported goods minus imported goods) had a value of 42 billion euro (ibid). An important note, however, is that goods such as meat, dairy, coffee, tea and certain processed goods are included in the agricultural section. Furthermore, around one fifth of agricultural exports are goods which are first imported into the Netherlands and exported after being processed (ibid). Nevertheless, the export of fruits and vegetables accounts for 17 per cent of agricultural exports, which is still a substantial amount (ibid).

As part of the national economy, agriculture is not the most important sector in the Netherlands. In 2011, the total gross added value of the sector 'agriculture, forestry and fishery' was 8.7 billion euro. This is only 1.6 per cent of the total gross added value in the Netherlands of 539.4 billion euro (data from: CBS Statline). Sectors which are more important are for example industry (19.5%), financial services (7.9%) and commercial services (11.1%) (ibid). However, the data of CBS do not take services into account which are related to the primary agricultural sector. According to a report by the Dutch ministry of Agriculture, Nature and Food Quality in 2004, the agricultural sector is responsible for 10 per cent of the national economy, when the secondary activities such as transport, processing and export are included.

What becomes clear, however, is that agriculture in the Netherlands has a completely different function than in a developing country such as Senegal. In the Netherlands, agriculture is a profitable sector rather than pure necessity. Yearly, it exports more food products than it imports. The Dutch agricultural sector has always been and still is successful because of several reasons. First of all, the physical conditions are favourable: throughout the country fertile land can be found and the climate is relatively mild. Second, Dutch farmers can benefit from a well developed infrastructure: the Netherlands has an extensive network of waterways and roads, which makes it easier to obtain the necessary inputs for farming and to transport products to the market. Third, the population density in the Netherlands is very high and a large percentage lives in urban areas. In 2010, the urbanization rate was 83 per cent of the total population (United Nations, Department of Economic and Social Affairs, Population Division, 2012). Although a higher concentration of urban settlement is found in the west of the country, cities are spread all over the Netherlands. Therefore, rural farmers benefit from

relative proximity to the cities, which provide them with inputs but which are also functioning as markets and distribution centres.

The Netherlands started to innovate and develop its agricultural sector rapidly after the Second World War. After the traumatic experience of food shortages and hunger during the war, one of the main objectives of the Dutch government was to ensure that there would be enough food. Economies to scale were seen as the way to efficient and sufficient production and the government initiated several programs to modernize Dutch agriculture. Therefore, we can see a sharp decrease in the number of agricultural holdings over the years, whereas the amount of land used has decreased only slightly, and production has gone up. Erwin Karel states that ‘between 1945 and 2010 the number of farmers in the Netherlands decreased from 400.000 to 70.000’ (Karel, 2010, p. 17). In his paper, he explains how modernization after the Second World War transformed the Dutch agricultural sector. He points to the industrial aspect of the sector: he argues that specialization in Dutch agriculture ‘turned farms into factories, which had to be managed like industrial plants’ (ibid, p. 14). Another aspect of agricultural modernization was the consolidation of land, which radically transformed the landscape by fusing pieces of land at the costs of rivers and streams and destroyed the traditional scenery. Furthermore, the new methods of production include use of pesticides and soil improvers, which had a negative impact on the quality of the groundwater and soil (ibid, p. 16).

During the last decades, however, the attitude towards large scale intensive farming has started to change. If Dutch farmers are already close to the cities, one might wonder whether urban agriculture is different from conventional agriculture. Why would people start growing food in the cities, if they already have it within a limited distance? The reason is that there are a number of transitions going on in the Dutch society. Transition expert Jan Rotmans has written a book on the changes which are currently transforming social, economic and political structures in the Netherlands. He defines a transition as a radical, irreversible change in a part of the society (Rotmans, 2012, p. 236).

One of the transitions which he discusses is the transition in the Netherlands towards a more sustainable food system. Agriculture, especially meat and dairy production, is responsible for 12 to 14 per cent of the total greenhouse gas emissions. Furthermore, animals are forced to live under unnatural conditions, which cause physical discomfort, unnatural behaviour, stress, and illness. The use of antibiotics in the livestock industry and the presence of dangerous bacteria impose a threat to our health. Furthermore, agriculture causes 40 percent of the acidification and 60 percent of the manuring of Dutch nature and water.

Moreover, the increase in the scale and intensity of farming leads to degradation of the soil, a decrease in biodiversity and change of the rural landscape. In addition, around 20 percent of our food is wasted, either in the wholesale business, production, retail, catering and at home. People are increasingly aware of these problems and are willing to change their consumption pattern, but find it difficult to determine where their food comes from and thus have difficulties to determine which products are sustainable and healthy (ibid, p. 51-52).

Nevertheless, sustainable development of the food system has attracted the attention of several groups of the Dutch society. During the last decades, NGO's have been campaigning, consumers have started to change parts of their consumption pattern, and producers increasingly offer 'green' or 'organic' products. At the political level, there is a certain resistance towards a transformation to a more sustainable food system. According to Rotmans, the political level still clings to old patterns and frameworks and tries to adapt the current system, whereas for a real change a more radical transformation is needed. Therefore, we can still find a strong political support for conventional farming, in terms of regulations and subsidies.

Another transition which is going on is related to the development of spatial and urban planning. Since the Second World War, the Dutch government has been actively engaged in the spatial planning of the country. During the last years, however, consumers expressed different wishes when it comes to housing and urban facilities. The current system of rules and restrictions has become too rigid for the demands of consumer today. In order to meet the needs for more sustainable spatial and urban planning, consumers, businesses, advisors, corporations and local governments increasingly cooperate and start new projects. Instead of top-down regulation, the citizen takes more initiative and the (local) government rather a facilitator. Urban agricultural projects are excellent examples of both transitions which are discussed here. Therefore, the following section explores the dynamics of urban agriculture in Amsterdam, the capital of the Netherlands, further in depth.

### ***3.2. Urban agriculture in Amsterdam***

Amsterdam is the capital of the Netherlands, and after Rotterdam its second biggest city with a number of inhabitants of 800.000. It lays in the western part of the Netherlands and falls under the 'Randstad Region', the most densely populated area of the Netherlands which consists of several adjacent cities. To begin with an example of urban farming in the city, there are a large number of allotment gardens in Amsterdam. This is probably the oldest form of modern Dutch urban agriculture and most of the gardens have been created many years

ago. At this moment, there are 39 allotment parks all over Amsterdam, which consist of roughly 6000 separate gardens (Van Schaick, 2007, p. 13). These allotment parks are property of the municipality and managed by garden associations. They are for rent at a subsidized rate and meant only for home consumption.

Anthropologist and agricultural expert Anke de Vrieze has done extensive research on green and urban agricultural projects in Amsterdam. Her findings are published in a report by the research unit CITIES in 2011, which sheds light on 19 different projects in Amsterdam which deal with sustainable (urban) development. One of those is “Vrouw en Vaart” (Woman and Canal), a development centre for women, which organises activities by and for women in the area of Amsterdam New West, and which has started the project “De Groene Vaart” (The Green Canal) three years ago. Through this project, the terrace which was previously covered by paving stones has now been turned into a garden with edible crops. The garden is designed according to principles of permaculture, a specific gardening technique which is inspired by nature. An important aspect of the project is the sharing of knowledge. The centre organises workshops and excursions, weekly meetings and common meals which are prepared with products from its own garden (CITIES, 2011, p. 2).

Furthermore, the foundation ‘Postzegelparken’ (Stamp Parks) has initiated a project whereby empty spaces in the city which have no longer a purpose are turned into green community spaces. The foundation gives advice to interested parties on design and use of materials, cooperates with the local government, inhabitants, entrepreneurs and corporations, and is involved in the organization of sponsoring of projects. Some of these projects are merely social, such as the establishment of playgrounds. However, a project which started in 2012 in Amsterdam-East includes the establishment of a butterfly garden, a herb garden, and a fruit tree orchard (ibid).

There are also private initiatives such as the commonly established kitchen-garden Trompenburg, which is set up by 12 persons who grow organic vegetables on small parcels. A few times a year, they eat together from their own harvested vegetables. Similarly, “Schoffeltuintjes Transvaal” are small gardens which are set up by residents in already existing green spaces in the city. Another similar project is that of Wiek de Keijser. His aim is transform places which are no longer used to green spaces and meeting places. In cooperation with neighbours he created a vegetable garden on a 1700 m<sup>2</sup> courtyard which is owned by a school. The neighbours are cooperation and share the harvest. For the future, the plan is to cooperate more with the school and make it also an educational project for children. Another project which involves schoolchildren is “Doetuin”, whereby schoolchildren help

residents around the school to turn their neglected backyards into vegetable gardens. The aim is to educate children about nature, gardening and food, and to stimulate contact between children and the residents. A third project where children are important participants is “De Brede Moestuin” (The Big Kitchen Garden), which is in cooperation with a playground association: around the playground vegetable garden are planted and maintained by the children. From the harvest, they have common meals once in a while (ibid).

An initiative which does not only combine social aspects with urban gardening, but also art is the project “De Kok, de Kweker, zijn Vrouw en hun Buurman” (The Cook, The Farmer, his Wife and their Neighbour). At the request of the Stedelijk Museum Amsterdam, it is designed by a group of artists, architects, designers and cultural producers. A housing corporation gave them permission to use a part of the building and terrain which was empty and for which there were no plans yet. The result was a vegetable garden, a communal kitchen and a place for art exhibitions. The project itself was only for a half a year from April until September 2009, but afterwards the Museum handed it over to the residents who continued to grow their vegetables (ibid).

Zuidpark Amsterdam is a project which renovated an old office building which had been empty for 2 years. It is completely renovated, and business can rent office space within the building. It is special because on its rooftop we find the largest Urban Farming roof in Europe of 3000 square metres. It is used and maintained by employees who work for the companies which are situated in the building. The harvest is used in the building’s cafeteria (Zuidpark, n.d.).

Very innovative is the idea of growing fruits and vegetables inside. “De Groenten uit Amsterdam” (The Vegetables from Amsterdam) has implemented this idea, in cooperation with architects, local organizations and corporations and Greenlung, a company which is specialized in green concepts. They make use of the PlantLab technology, which makes it possible to grow plants inside, completely isolated, and with the use of LED lights. Compared to normal greenhouses, it uses 90 per cent less water, less electricity, it eliminates the use of any pesticide and instead of horizontal space, and it can make use of vertical space. Furthermore, the technology is suitable for farming at any scale. In addition, the vegetables are said to be of better quality in taste. In Amsterdam, they started to implement this idea, in an old typewriter factory which had not been used for eleven years. The initiators of the project claim that this way of growing vegetables is more efficient, because of the following reasons: first, they use less energy and water. Second, they reduce the food miles per product by producing and selling in the city. And third, they can calculate exactly how much they can

produce and how long it takes for a crop to ripen. Therefore, they can exactly produce the amount which is demanded and when it is demanded, limiting eventual waste of products (De Groenten uit Amsterdam, 2011). With regard to a more sustainable future, the PlantLab technology looks promising. Nevertheless, more research needs to be done, before any conclusion can be drawn from this single project.

As a reaction to the emerging trend of urban agriculture, a number of entrepreneurs responded by offering related services or materials. The shop “Urban Green” opened its door in 2010, selling plants and a wide range of tools for urban gardening. In addition, they provided their customers with advice on where and how to grow their crops. Although the idea was original and promising, the shop did not survive and had gone bankrupt by the end of 2011. According to Liesbeth Glandorf, the failure could mainly be attributed to the economic crisis and bad weather conditions for gardening (De Boomkwekerij, 2012). A number of other initiatives, however, still exist. Take for example “City Plot”, a commercial organization which organizes (tailor-made) workshops and gives advice on urban garden design (CITIES, 2011, p. 4).

In addition to projects and services which are related directly to the growing of vegetables, there are also initiatives which deal with the distributional and sales aspects of the food system. “Thijl” is a young entrepreneur who offers home delivery of bio-products by carrier cycle. People can make their order online at a specific shop which organic products, and make an appointment with Thijl for the delivery (Thijl, n.d.). Although the means of transportation within the city is absolutely more environmental friendly than grocery shopping by car, the “organic” products are not necessarily produced locally. On the contrary, a large number of the fruits and vegetables are grown organically in France, Spain or even non-European countries, after which they are transported to the Netherlands (Odin Winkel, n.d.).

However, for people who prefer to consume locally produced products but do not want or do not have the means to grow fruits and vegetables themselves, there are other initiatives whereby consumers collectively makes deals with farmers in or around Amsterdam. “VersVoko” is such an initiative. It is run by volunteers who are involved in processing of orders as well as distribution. The aim is to support local agriculture and decrease food miles, and to have fresh high quality produce. The construction is also known as ‘Community Supported Agriculture’: it is indeed a small community which guarantees a number of farms that a part of their production will be purchased (CITIES, 2011, p. 2).



As a result of the expansion of the city, rural areas and some of their farms have been absorbed. The farmers which are located in these peri-urban areas profit from the proximity of consumers. It allows them to initiate other activities than farming only, such as workshops, tourism, or social projects. An example is Kwekerij Osdorp, a vegetable farm, which is located at the edge of Amsterdam. In addition to a team of regular employees, between 45 and 46 employees are people who are unemployed and have an unfavourable position at the labour market. The project is designed as to give them work experience, in order to be able to find a job more easily. They can work 1 to 4 days a week, receive remuneration and lunch, and they are coached by specialized supervisors. The local government is owner of the land, but leases it out to the farm. Although the farm received subsidies from the local government until 2011, it is now a self-supporting company which is not dependent on any type of sponsoring (Kwekerij Osdorp, n.d.). Similarly, there are so-called ‘care-farms’: these are farms close to Amsterdam, where physically or mentally disabled persons can work and/or live. There is professional guidance which pays attention to the specific needs of the people, who are working on the farm or in their farm shop.

In addition to all of these projects and initiatives, there are a number of platforms where people meet and exchange knowledge and ideas about a greener future of Amsterdam. Also the municipality of Amsterdam is willing to facilitate urban farming and tries to improve the bureaucratic procedures which it involves. Urban farming is related to different policy areas, and therefore it is difficult to establish clear guidelines for urban agriculture. Consequently, new initiatives for urban farming often encounter constraints due to rules with regard to spatial planning. However, in April 2013 the local council adopted a proposal which establishes a special information counter for urban agriculture, which is open to any interested party. It seems as if urban farming is popular and has many enthusiastic supporters. In order to find out to what extent urban agriculture contributes to the urban sustainability of Amsterdam, the following sections deal with the economic, social and environmental issues which are related to urban farming in Amsterdam.

### ***3.3. Economic sustainability***

#### **3.3.1. Urban agriculture and income**

The motivation for people to engage in urban agricultural activities in the Netherlands is rarely economic: most of them express their concerns about the current food system and its sustainability. Moreover, the activities are usually performed in their free time. In addition, farmers who grow fruits and vegetables on an allotment garden are not allowed to grow

anything for commercial reasons: the allotment gardens are provided by the municipality at a subsidized rate and serve only for home consumption. The exceptions are the peri-urban farmers, who are often former rural farmers that have been absorbed by the city due to its expansion. Another exception is PlantLab, the technology which makes it possible to grow plants inside with artificial light. However, all of the small scale urban farmers who act on their own or in small communities are mainly volunteers who do it in addition to regular employment. In some cases, where the projects receive funding from the local government, organisers or volunteers receive remuneration. The harvest which these communities gain from their production is usually not for sale, unless in the case of surpluses. Instead, it is for private use or they make meals from it together. Although urban agriculture might serve as small income substitution because urban farmers need to buy fewer products, it is not used as a means to generate income and finance things such as housing or school fees.

However, if commercial initiatives such as those of PlantLab and the rooftop garden in Zuidas succeed and expand, urban agriculture may become a more profitable activity than it is at the moment. It is difficult to predict the behaviour of consumers, who are determining actors when it comes to the implementation of new ideas. Without demand for sustainable alternatives to the current food system such as urban agriculture, new ideas will not hold. Nevertheless, the Dutch society seems to be in a transition, which will cause shifts in consumption and production patterns.

### **3.3.2. Labour market**

Urban farming is for most people in Amsterdam an additional activity to their regular employment. With the exception of a few commercial initiatives, they produce fruits and vegetables in their leisure time. The people involved range from social workers to volunteers, pensioners and children. Regardless of the scale of urban agriculture, it does not contribute significantly to the creation of employment if it remains largely based on voluntary action.

Promising alternatives are for example the ideas of PlantLab, which aims at commercially growing fruits and vegetables in empty houses in Amsterdam, or Community Supported Agriculture such as VersVoko. The latter especially stimulates peri-urban farmers, who produce vegetables on a bigger scale than people in community gardens within the city, and who do it professionally. Community Supported Agriculture benefits both the producers and the consumers. The producers can rely on a constant demand for high quality organic products, and therefore do not need to compete with their conventional farming counterparts,

who can produce at a lower price. The consumers, on the other hand, are ensured with a constant supply of high quality products which are produced and distributed in an environmental friendly way. Another example of peri-urban farming is Kwekerij Osdorp, a vegetable farm at the edge of Amsterdam which employs people who have trouble finding a job on the regular labour market. This project creates jobs for people from weaker social groups and helps them to integrate in the regular labour market. This farm is an excellent example of a sustainable farm, which aims at producing in an environmental friendly way and reintegration of socially weak groups into the society, without being dependent on subsidies or other types of sponsoring.

The number of commercial initiatives is still small, and it is still unclear if they will be able to survive. Possibly, the current economic climate is not favourable to sustainable development. Currently, the Netherlands faces an unemployment rate of 8 percent and the housing market is in a depression. Furthermore, governments at all levels in the Netherlands have to economize, including the municipality of Amsterdam. In times of economic crisis, sustainable development is not a priority at the governing levels, and neither for families which have less money to spend than a few years ago. Nevertheless, so far the interest in urban agriculture only seems to increase, among consumers, companies and also at the municipal level, which is open to new ideas to fill up empty spaces in the city. Due to the economic conditions, there are more vacant spaces like old offices which are no longer in use. Perhaps the economic difficulties of today are an extra stimulus to make a transition to a more sustainable food system, in which countries, cities and individuals become more self-supporting. The upcoming years will show how the interest for urban agriculture develops, and it is necessary that more research is done on this topic.

### **3.3.3. Access to land and water**

Most of the urban agricultural projects are either privately organized or dependent on public funds and sponsoring. Allotment gardens can be found on several places in Amsterdam, and are for rent, often at a subsidized rate of the municipality. Usually, there is a coordinating association which takes care of common facilities. At the moment, there is a high interest in allotment gardens and most of them have a waiting list. For people who are unable to get a garden, it is possible to participate in one of the other urban farming projects in Amsterdam. However, some of the projects are dependent on availability of space and the willingness of the local government to give them permission to use it for urban agriculture. Projects are usually granted permission for a period of time, with the uncertainty of having the permit in

the future. Alternatively, urban farming is practised on private property such as backyards, other open spaces, or rooftops and balconies. The majority of places are well connected to the watering system in Amsterdam, and water is therefore available. In addition, some people choose to catch rainwater and use it for irrigation of their plots. Water is thus sufficiently available, land is scarcer.

However, land scarcity is not necessarily a big problem. It is also possible to grow fruits and vegetables on rooftop gardens or balconies. Moreover, there are a number of scientists who examined the possibilities of ‘vertical farming’, which means that vegetables are no longer grown on land but by other techniques, with the use of special constructions, light, water, nutrition substrates, CO<sub>2</sub> and the right temperature. PlantLab is such a technology, whereby plants are grown completely isolated inside with the use of LED lights. For vertical farming, vacant spaces such as old offices or factories can be used.

When it comes to professional farming, entrepreneurs find most space at the edges of the city. In a country where the population density is high and where there is an increase in demand for land for recreational, agricultural and touristic purposes, land prices are high. Especially close to urban areas, where there is a demand for space for housing, urbanization drives the prices up. Therefore, start-up costs for a (peri-)urban farmers are higher than for rural farmers. On the other hand, urban farmers benefit from the proximity of the city: they can save on transportation and distribution costs, they reach consumers more easily, and it is easier for them to combine farming with another activity which involves urban residents (such as workshops, recreation, tourism, social projects etc) and generate extra income to compensate for higher land prices.

### **3.3.4. Efficient use of materials**

On the one hand, agriculture in the city seems less efficient: it takes more time and when you grow vegetables on a small scale you spend relatively more on inputs such as tools and knowledge. On the other hand, if other factors such as air quality, health, and the benefits of a green environment could be expressed in money and taken into account when you look at the outputs of urban agriculture, the conclusion could be different. At the moment, such facilities are taken for granted and seen as free goods. From a perspective in which negative side effects are not expressed in monetary value, conventional agriculture may be more efficient. However, as already discussed in an earlier section, the limits of the Dutch conventional food system have become more apparent. It is heavily dependent on fossil fuels in all stages of the process and has adverse side effects on the environment. Urban agriculture can alleviate the

burden of the current food system, and thus make it more economically sustainable and efficient.

### ***3.4. Social sustainability***

#### **3.4.1. Food security**

Currently, food security is not an issue in the Netherlands. It is a wealthy country where the majority of people have enough income to purchase a sufficient amount of food. Furthermore, the Netherlands has an agricultural sector with a high productivity and is a net exporter of food products. However, as pointed to in earlier sections, the current food system is heavily dependent on fossil fuels. It uses fertilizers which consist of or are made from fossil fuels, it uses machinery which runs on fuel, and it is dependent on fossil fuels for the processing and distribution of the products. Urban agriculture is a greener alternative: it is performed on a smaller scale without use of machinery and can be performed without chemical fertilizers. In addition, it can save on conservation, packaging and transportation costs due to the fact that the consumers are located in the proximity of the production sites.

However, it has to be taken into account that urban agriculture cannot replace conventional agriculture. Although some places in the city are suitable for the growing of fruits and vegetables, staple crops need more space and are therefore easier produced in rural areas. The extent to which urban agriculture could contribute to the total production of agricultural products depends on the interest of urban residents to farm, the willingness of local governments to cooperate and facilitate, on the success of commercial initiatives, and on the development of technologies which make urban agriculture more productive.

It is difficult to determine the current scale of urban agriculture and its potential in the future. Most of the production so far is used for private consumption which makes it difficult to estimate its value. The commercial initiatives are in an early stage, and although some of them seem promising, they will have to prove themselves during the upcoming years. Whereas some claim that urban agriculture can provide for 10 per cent of the local food supply (NICIS, 2012), others are even more optimistic: Jurgen Hoogendoorn from the Amsterdam Development Department argues that if all vacant buildings in Amsterdam are used for farming with high-tech grow technologies, it can provide food for 2.6 billion people, which is 3 times as much as the current population of Amsterdam (Dienst Ruimtelijke Ordening, 2010, p. 7).

### **3.4.2. Equity**

There are several groups who can benefit from urban farming. First of all, the farmers themselves can produce fresh fruits and vegetables for home consumption or sales in the cases of surpluses. Second, consumers are provided with good quality products and are better able to trace where their food comes from, which strengthens their confidence in the food sector. Third, a number of project give people who have a socially weak position in the society a chance to spend their time, meet other people, learn about farming and gain working experiences. Examples are (female) immigrants, physically or mentally disabled, people with psychological problems, homeless people and drug addicts. Fourth, everybody in the city benefits from a better environment, e.g. better air quality and more green spaces. Regardless of one's background, salary or knowledge, there are possibilities for everyone to participate in urban farming.

### **3.4.3. Health**

According to a study by the Dutch Health Council in 2004, green spaces have a stress reducing effect. They are found to have a positive effect on mood, concentration, self-discipline and physical stress. Depression and anxiety disorders frequently occur among Dutch people and are a cause of absence through illness at work and working incapacity. Participation in urban agricultural project could possibly reduce this number. Furthermore, it could help people to be more active physically. Only a minority of the Dutch population (45 per cent) reach the minimum standard of physical exercise (at least 30 minutes, 5 days a week) (Gezondheidsraad en RMNO, 2004, p. 17). It can also have a positive effect on the health of children: being active outside is a better activity than playing computer games at a computer or watching television. According to a study by the Dutch Health Council in 2004, children develop their cognitive, social-emotional and motorial skills better when they have access to green spaces (ibid, p. 19). However, in order to determine the extent to which urban agriculture contributes to a better health of the urban dwellers, more research needs to be done, as a link between health and urban agriculture specifically is not yet clear. However, for people with a physical or mental disability, urban agriculture can be a pleasant pastime. The so-called 'care-farms' in a village close to Amsterdam provides them with a possibility to work and/or live at their organic farm. They are accompanied by trained social workers, gain work experience, make contact with their colleagues, are physically active and contribute to the harvest of the farm.

### **3.4.4. Education**

When starting an urban farm or garden, it is useful to gain knowledge about the process of growing fruits and vegetables. In the Netherlands has a literacy rate of almost 100 per cent, and information on gardening is freely available on the internet or in libraries. Furthermore, there is a growing offer of workshops and there are platforms where people exchange knowledge. Professional farmers can attend an agricultural programme of one of the higher profession schools or universities. The access to knowledge about crop cultivation is therefore very good.

If we look at it from another perspective, we can see that urban farming itself also provides for chances to learn. The projects which involve children are partly designed to teach them about gardening but also about its wider background which is related to, for instance, nature and sustainability. The urban farming projects are a playful way for children to learn about plants, nature, animals, and gardening techniques. However, the educational aspect of urban farming is not necessarily restricted to children. As the example of women development centre 'De Groene Vaart' shows, there are more social groups who are interested in learning about gardening, nature and health. The farms at the edge of the city which provide a working pace for mentally or physically disables, or for other people who are far from the labour market such as homeless people or drug addicts, also function as a place to learn.

## ***3.5. Environmental sustainability***

### **3.5.1. Air quality**

Compared to rural areas, the quality of air is worse in cities in the Netherlands. This is also the case for Amsterdam, which is located in the west of the country, the region with the highest population density. Within Amsterdam, differences in air quality are measurable at different places. According to data from the Municipal Health Department (GGD Amsterdam), the air quality is significantly better in green spaces. The concentration of pollutants such as carbon and nitrogen dioxide was higher in green spaces than in other places of the city (GGD Amsterdam, 2012). Although this might be explained for a large part by the fact that in such green spaces are less pollutants such as cars, greens spaces also have a cleaning effect on the air. Although urban agriculture was not included in this research, it is plausible that it has similar effects on the air quality as other green spaces.

What needs to be examined, however, is how that quality of air affects urban farming. Urban farming can have a positive influence on the air quality of Amsterdam, but is it safe to

produce fruits and vegetables in an urban environment? The biggest rooftop garden in Europe is located in Amsterdam next to a busy high way. Busy roads and highways are two of the places where the concentration of particulate matter in the air is the highest. Human beings who are exposed to particulate matter have a higher risk to respiratory problems and lung cancer. Therefore, it is questionable whether farming on a rooftop next to a highway is a healthy activity, regardless of eventual other benefits. Furthermore, particulate matter is known to negatively affect the growth of plants. However, it is unclear whether the consumption of vegetables which are exposed to particulate matter negatively affects human health.

### **3.5.2. Water quality and management**

In contrast to the scarcity of land, the Netherlands has water in abundance. First of all, it lays for a large part below sea level and there are many rivers, canals and streams. And second, due to its moderate climate the Netherlands has a high precipitation rate. Therefore, the Netherlands have an extensive system of canals and pumping stations to keep the water level within the country at a normal level. In cities, however, an increase in surface of paving stones leads to a worsening in the absorption of water by the ground, and hence in an overburdened sewage system. Urban farming and gardening can improve this by turning paved surfaces into green spaces which absorb more water and relieve some of the pressure on the sewage system of the city.

Furthermore, urban agriculture is less contaminating than conventional agriculture. The large scale farms which cultivate intensively use chemical fertilizers which are drained away by the water. Therefore, the groundwater as well as the water in canals and rivers has high concentrations of chemicals which affect its quality and biodiversity. Urban agriculture without use of chemical fertilizers is less contaminating and can have a positive effect on the water management of Amsterdam, as explained in the paragraph above.

### **3.5.3. Soil quality**

As discussed before, conventional Dutch agriculture puts constraints on the soil and water quality by cultivating intensively and by using chemical fertilizers. Urban farming is a greener alternative, but some question marks could be put when examining the soil quality of the city. Amsterdam has, like any other city, a high population density. Consequently, there are more cars, industries and other pollutants. Therefore, one might wonder whether its soil is actually suitable and safe for farming.



In several places in the city, the soil is contaminated with substances which do not belong there, such as lead. A research has been conducted and the Dutch Institute of Public Health and Environment published the results in a report (RIVM, 2012). According to this report, high concentrations of lead in the soil do not lead to similarly high concentrations in the crops which are cultivated. In fact, the uptake of lead by plants is much lower than previously thought. Therefore, the researchers plead for fewer restrictions when it comes to farming on lead-contaminated soil. According to the report, the maximum allowed concentration of lead can be adjusted downwards. Furthermore, they found a difference in uptake of lead by different crops. Leafy vegetables such as lettuce and spinach were found to contain more lead than vegetables or fruits which are grown on a larger distance from the ground (RIVM, 2012, p. 19-20). In addition, the farmer should still be aware that the ground which can be on the vegetables can be contaminated. However, it should be sufficient to wash vegetables well before use. Other contaminants which are often found in urban soil are PAHs (polycyclic aromatic hydrocarbons). According to Paul Romkens, researcher and soil expert, no relationship has been found between soil contamination of PAHs and increased levels of toxics in vegetables. It can be concluded that plants take up no or fewer toxics from the soil than previously thought and that certain restrictions on soil utilization may become less rigid (Eetbaar Rotterdam, 2011).

#### **3.5.4. Use of pesticides and fertilizers**

Urban agriculture in Amsterdam is characterized by its low use of chemical fertilizers and/or pesticides. The urban farmers are generally aware of environmental issues and as the majority grows vegetables for home production instead of commercially, they are not under pressure to produce crops at a large quantity and within a short period of time. Quality of the final product and the recreational and social aspects of urban farming are more important. Therefore, they are reluctant to use chemicals for fertilization or to control pests. In allotment gardens, prohibition on the use of chemicals and environmental unfriendly substances is usually included in the regulations of the allotment parks. The majority of projects such as community gardens, educational projects or care farms aim at producing in a sustainable way and therefore also restrict use of environmental unfriendly substances. The initiatives, whereby fruits or vegetables are grown vertically and/or inside make use of special techniques, through which the use of chemicals becomes unnecessary. Thus, when compared to conventional agriculture at this aspect, urban agriculture is absolutely a greener alternative.

### ***3.6. Sustainability of urban agriculture in Amsterdam***

Although allotment gardens exist for a longer time, most of the urban agricultural projects in Amsterdam are relatively new. During the last years, there has been an explosion of different initiatives, some more successful than others. It seems as if there is a transition going on in the Dutch society, in which the food system, among other, undergoes changes towards a more sustainable future. Urban agriculture in Amsterdam looks promising: there is an increasing interest in urban farming by private parties, commercial entrepreneurs and the municipal government. Optimists argue that Amsterdam could become fully self sufficient, realists with a more nuanced opinion point to the possibilities of urban farming to provide at least partly for the local food supply.

So far, however, the main motives behind urban farming are mainly social: the projects involve educational aspects, health, women empowerment, care, and social cohesion. On all of these aspects urban agriculture has a positive impact. In a playful way, urban agriculture brings people closer to green spaces, enhances social contacts, raises awareness about food and health, and provides for a pleasant pastime. Also from an environmental perspective, urban agriculture has a predominantly positive influence. Although attention should be paid to risks related to air, soil and water contamination, urban farming seems to experience little effect from pollution and can actually contribute to a healthier urban environment.

Nevertheless, in order to have a long-lasting contribution to the sustainable development of Amsterdam, it would need further development. Many of the projects are based on voluntary work and dependent on leisure time. People engage in urban agriculture because they find it a pleasant activity in their free time. Preferences and trends can change over time, and until now economic motives barely play a role. Possibly, increasing awareness about the limits of the current food system encourages more and more people to participate in urban farming. However, as the supermarkets in Amsterdam do not show any sign of shortages, it may well go in a different direction.

Commercial urban farming would need to be more developed. At this stage, the initiatives look promising, but little can be said about their success. They will need to prove themselves during the upcoming years. But in the case that interest will grow further, there are enough possibilities. New technologies provide techniques which are particularly suitable for urban farming. Furthermore, the municipal government is trying to remove barriers which still hinder innovative and creative ideas. With cooperation between all interested parties, there are absolutely fruitful opportunities for urban agriculture in Amsterdam.

## Comparison and conclusions

As the previous chapters have shown, urban agriculture is a topic of current interest among academia as well as in the civil society. Although it is not a new phenomenon, it has gained more attention during the last years. With regard to the global South, hunger and food security are topics which are often discussed at local and national, but also international levels. Furthermore, rapid urbanization in the South raises questions about the possibilities to feed its growing urban population. Due to its relation to these important topics, urban agriculture in the South is therefore deservedly given attention. But also in the North, questions about a sustainable future are raised. The limits of the current food system have become more apparent and people are in search of more sustainable alternatives.

In order to shed light on the dynamics of urban agriculture in the global South as well as in the global North, this paper conducted a comparative case study. It has given an overview of existing literature on urban agriculture, with the purpose of explaining the diversity of urban farming. Due to the limits of this paper, a choice has been made to focus only on cultivation of crops such as vegetables, fruits, grains and mushrooms within urban and peri-urban areas. Furthermore, it established a concept of urban sustainability, which is comprised of an economic, social and environmental dimension. It defined sub-criteria for each of the dimensions, which have been applied to both of the cases. In the chapters that followed, the cases of Dakar and Amsterdam have been discussed in depth, which enables us to compare them.

With the aim of finding out to what extent urban agriculture contributes to the sustainability of Dakar and Amsterdam, this paper has discussed the economic, social and environmental criteria for urban sustainability in depth. For both Dakar and Amsterdam, a clear cut answer to the research question is difficult to give. As the previous chapters have shown, urban agriculture in both cities has its advantages and disadvantages, and does not clearly either foster or hinder urban sustainability. However, for a city to be overall sustainable, it needs to be economically, socially and environmentally sustainable. These conditions cannot be fulfilled in either of the two cases. Therefore, the answer to the first part of the research question (i.e. to what extent does urban agriculture contribute to urban sustainability) is that at the time of writing urban agriculture does not significantly contribute to urban sustainability in Dakar and Amsterdam, despite its potential to do so.

The second part of the research question deals with the comparative aspect of the research. The two cases perform differently for each of the urban sustainability criteria. When we take a look at the economic aspects, the most striking difference between the two cities is that urban agriculture in Dakar is an important economic contributor in terms of income and employment, whereas urban agriculture in Amsterdam is often a leisure and/or voluntary activity. Dakar is for a large part self-sufficient in fruits and vegetables due to its urban agriculture, whereas in Amsterdam urban agriculture rather serves other purposes than income or food security.

However, in both cases, urban agriculture has a stimulating effect on the labour market. In Dakar, urban farming creates a spill over effect to other sectors, by creating a demand for other services which are related to the supply of materials, or the distribution, transportation and processing of agricultural products. In Amsterdam, where there are few commercial urban farming projects, urban agriculture plays a role in the (re)integration of socially weak groups in the regular labour market, by creating places where people with mental or physical problems can gain work experience.

With regard to access to land and water, both cities encounter constraints. A characteristic of a city is that land is scarce, and this has its effects on the availability of land for urban agriculture. In Dakar, institutional weaknesses in combination with strong local traditions of customary law provide the urban farmer with little security with regard to land tenure. Furthermore, water is a scarce resource, through which urban farmers are inclined to use untreated waste water for the irrigation of their plots. In Amsterdam, access to land can be a problem due to strict urban planning. However, in contrast to Dakar, access to land is less dependent on social and economic status. Whereas in Dakar, the poor are more vulnerable to land expropriation, in Amsterdam it is possible to participate in urban farming regardless of a person's background. Furthermore, the Amsterdam municipality shows willingness to relax some of its principle and is increasingly open to urban farming initiatives. New techniques provide a partial solution to the problem of land scarcity. In Dakar, micro-gardening is practised by a large number of families, and in Amsterdam there are experiments going on with vertical farming and the growing of vegetables inside old office buildings.

Both cities show that urban agriculture leads to a more efficient use of resources. Although it seems paradoxical to grow fruits and vegetables on a small scale, where returns to inputs are relatively smaller, it is more sustainable when compared to agriculture which is heavily dependent on fossil fuels. This is especially the case in the Netherlands, which has a productive rural agricultural sector, but which is not sustainable in terms of its dependence on

natural resources. However, future development of urban agriculture in Amsterdam will need to show in how far urban farming can compensate for losses in the rural agricultural sector, as the number of commercial initiatives is still small. In Dakar, urban farmers make efficient use of resources such as fish waste, peanut shells, rice chaff and waste water, which is widely available in the city and which allows them to economize on more expensive inputs.

In terms of economic sustainability, both cases face different problems. However, Dakar seems to be more economically sustainable when it comes to urban agriculture than Amsterdam, due to its scale, its contribution to income and the labour market and efficient use of available resources. Amsterdam scores better on the criterion of access to land and water, but as far as the other criteria are concerned its economic sustainability is weak.

The two cities also perform differently on the social criteria of urban sustainability. This is partly due to the different nature of urban farming in both cases, but also to their background. For example, food security is a greater issue in Dakar than in Amsterdam. Therefore, urban agriculture is more important to sustain food security in Dakar than in Amsterdam. Nevertheless, it should be noted that food security may play a greater role in Amsterdam in the future, due to the unsustainability of its current food system. However, at the moment citizens of Amsterdam are not dependent on urban agriculture for their daily food supply.

As already discussed partly above, not everybody benefits equally from urban agriculture. For example, in Dakar, the urban poor and women face more difficulties to gain access to land than those who can afford to secure land rights or have a higher social status. Nevertheless, urban agriculture does provide opportunities, in the form of micro-gardening but also by creating a demand for services such as sellers. The latter is often performed by women. In Amsterdam, access to urban agriculture is more equally distributed. In addition, it attempts to include people from weaker social groups in the society and labour market.

Urban agriculture can contribute to a better health, by providing fresh and high quality produce. However, in the case of Dakar, question marks should be put by the quality of the products. Although it is certainly an advantage of farming in the city that products need to travel shorter distances and within less time, the use of untreated waste water imposes a sanitary risk. In addition, the level of pesticides often exceeds the recommended limits. In Amsterdam, these risks are lower because people tend to use environmental friendly fertilizers and they have access to clean water. Furthermore, green spaces provide opportunities for recreation and relaxation, which contributes to a better physical and mental health.

This paper also investigated the relationship between urban agriculture and education. A striking but not surprising result was that the lack of education negatively affects urban agriculture in Dakar. A high illiteracy rate and lack of information leads farmers to take unnecessary risks with regards to use of waste water and pesticides. In Amsterdam, information on urban farming is widely available to those who are interested. In turn, urban agriculture also provides opportunities for learning, and projects in Amsterdam make use of this function. They involve women, children and other people, and educate about nature, health, food and sustainability.

Amsterdam clearly scores better on social sustainability, which is mainly due to its multi-functional character of urban agriculture. In Dakar, on the contrary, there is a lot of space for improvement of social sustainability. Although it does not mean that urban agriculture in Dakar cannot have multiple functions, economic motives are the main drivers to engage in urban farming.

When comparing environmental sustainability in both cities, it should be noted that it is difficult to draw conclusions due to a lack of data. For example, it is plausible that urban agriculture contributes to better air quality, due to the absorbing ability of plants of CO<sub>2</sub> and particulate matter. Although in Amsterdam, research has been done to the relationship between green spaces and air quality, it is difficult to find similar data on Dakar.

Data on water and soil quality is available, and it gives a mixed view on the advantages and disadvantages of urban agriculture. Although urban agriculture prevents degradation of the soil, by holding it together with the roots of the plants, the use of waste water, pesticides and fertilizer have a detrimental effect on its quality as well as on the quality of groundwater. In Amsterdam, urban farming is more environmental friendly, but the question is whether the current environmental quality of the soil and air does not negatively affect the crops. Although research so far suggests that there are no significant risks to health, this should be studied in further depth.

Thus, when it comes to environmental quality and the contribution to it by urban agriculture, Amsterdam seems to perform better than Dakar. Although in both cases, urban agriculture can contribute to better quality of air, soil and water, in Amsterdam more attention is given to these issues than in Dakar. Whereas in Amsterdam, urban farmers attempt to grow their crops in an environmental friendly way without chemicals and pesticides, in Dakar the use of chemicals and untreated waste water is common. An explanation for this might be again the lack of education but also the pressure to produce a sufficient amount to sustain a living. For urban farmers in Amsterdam, gaining income is usually not the main objective and

therefore they might feel less pressure to maximize their production. On the other hand, economic motives in Dakar stimulate farmers to make efficient use of the available resources: they economize by using waste water and other organic waste for fertilizing, and cut spending on fertilizing substances. Furthermore, the scale of urban agriculture in Amsterdam is key when it comes to its contribution to environmental quality. Therefore, the upcoming years will need to show the development of urban agriculture, its decrease or increase in scale, and thus its impact on the environment.

In conclusion, urban agriculture in Dakar and Amsterdam is different and relates to urban sustainability in different ways. In both cases, however, it lacks sufficient economic, social and environmental sustainability to say that it contributes significantly to the urban sustainability of the cities. Nevertheless, this paper has also shown that urban agriculture in Dakar and Amsterdam both have potential to contribute to a more sustainable future, provided that attention is given to the challenges mentioned above. Although these cities are different in many aspects, they share the potential for a more sustainable future, each in their own way. This paper has highlighted the most important issues which allows developing policies to stimulate urban sustainability. In Dakar, this includes strengthening of land security and equal access to different social groups, better education and more research to the relationship between the environment and urban farming. In Amsterdam, this includes further stimulation of urban farming initiatives, e.g. through tax incentives and subsidies, making space available for urban agriculture, and combine private and commercial interests.

As we have seen, urban sustainability is a complex issue which is related to many different factors. This paper made use of existing research on urban agriculture in Dakar and Amsterdam, but encountered a lack of precise data in some areas. Therefore, it strongly encourages further research. In Dakar, more research can be done on the relationship between the environment and urban agriculture, looking at air, water and soil quality. In Amsterdam, it will be interesting to see how urban agriculture develops. Therefore, this paper calls for further research, which gives a better insight in the scale and profitability of urban agriculture in the Dutch capital. Moreover, it might be helpful to find out more on the role of livestock keeping in the cities of Dakar and Amsterdam. Livestock breeding and horticulture may well complement each other, but the economic, social and environmental effects of livestock keeping should be examined in more depth. Furthermore, this paper encourages research on methods to improve the conditions for urban agriculture, such as institutional factors. Especially because of its potential, it is important to keep on studying the development, challenges and opportunities of urban agriculture. However, it should be noted that urban

sustainability is related to other issues than urban agriculture as well. In order to determine urban sustainability, also other areas should be studied, such as consumption patterns, use of energy, sustainable housing and infrastructure. As mentioned before, urban sustainability is a complex issue, but in order to pave the way for more sustainable cities, it is necessary not to avoid such difficult issues. By exploring them piece by piece, it is possible to gain a better understanding of overall sustainability and allow changes to occur in our society.



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